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MAIN OFFICE—STATE BOARD OF HEALTH.

NINTH REPORT

OF THE

STATE BOARD OF HEALTH

OF THE

STATE OF MAINE

FOR THE

Two Years Ending December 31, 1895

1894-1895

AUGUSTA
KENNEBEC JOURNAL PRINT
1897

MAINE STATE BOARD OF HEALTH.

OFFICE OF THE SECRETARY,
AUGUSTA, ME., October, 1896.

To His Excellency, Henry B. Cleaves, Governor, and the Honorable Executive Council:

GENTLEMEN: I have the honor of submitting to you the Ninth Report of the State Board of Health of Maine, it being the Second Biennial Report and for the years 1894 and 1895.

Very respectfully,

A. G. YOUNG, M. D.,

Secretary.

MEMBERS OF THE BOARD—1894.

CHARLES D. SMITH, M. D., *President*,	Portland.
E. C. JORDAN, C. E.,	Portland.
Prof. F. C. ROBINSON,	Brunswick.
A. R. G. SMITH, M. D.,	North Whitefield.
G. M. WOODCOCK, M. D.,	Bangor.
M. C. WEDGEWOOD, M. D.,	Lewiston.
A. G. YOUNG, M. D., *Secretary*,	Augusta.

MEMBERS OF THE BOARD—1895.

CHARLES D. SMITH, M. D., *President*,	Portland.
E. C. JORDAN, C. E.,	Portland.
Prof. F. C. ROBINSON,	Brunswick.
A. R. G. SMITH, M. D.,	North Whitefield.
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LABORATORY—VITAL STATISTICS.

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INTRODUCTORY.

Though presenting a record of the routine sanitary work in the State for the two years ending December 31, 1895, this report gives the results of some of the special work of the Board to the end of the year 1896.

One of the special lines of work has been the determination of the value of formic aldehyde gas as a disinfectant. In the autumn of 1895, Professor F. C. Robinson was requested to carry on this work for the Board, and, if practicable, to devise an apparatus for the generation of the gas in quantity sufficient for the rapid disinfection of rooms. The formic aldehyde lamp was exhibited at the meeting of the American Public Health Association in October, and a brief paper was read giving a summary of the results which had been obtained with its use. The great interest in the subject shown at the meeting, and the very numerous letters since received from the state and municipal health officers all over this country, with a few from European sources, show that an efficient gaseous disinfecting agent, with a trustworthy method of using it is a great desideratum in sanitary work. In addition to the paper to which reference is made, this report contains another by Professor Robinson, which gives a more detailed statement of the results obtained in testing the efficiency of formic aldehyde as a disinfectant.

In a paper by Dr. C. D. Smith, who constitutes the Board's committee on vaccine lymph, antitoxin, and other inoculation material, a valuable resumé of practical information relative to the antitoxin treatment of diphtheria is given.

The paper by Professor Woodbridge of the Massachusetts Institute of Technology is a very valuable contribution to its subject. The two papers on filtration are both able presenta-

tions of the modern requirements of filtration and how it may be accomplished. The construction of the domestic filter herein illustrated is based upon the intimate knowledge of an expert and a leading authority on potable water and water supplies. The apparatus is undoubtedly efficient, though, so far as is known to the Board, no bacteriological tests have been made.

SECRETARY'S REPORT.

The names and addresses of the members of the Board at the end of the year 1894, with the date of expiration of their terms of office were as follows:

Professor F. C. Robinson, Brunswick, term expiring January 31, 1895.

G. M. Woodcock, M. D., Bangor, term expiring January 31, 1896.

C. D. Smith, M. D., Portland, term expiring January 31, 1897.

A. R. G. Smith, M. D., North Whitefield, term expiring January 31, 1898.

E. C. Jordan, C. E., Portland, term expiring January 31, 1899.

At the annual meeting, in March, Dr. C. D. Smith was unanimously re-elected President for the ensuing year. At this same meeting the Secretary reported that the continued prevalence of small-pox is shown by the unusual number of notifications that continue to come from other State Boards reporting epidemics of that disease.

The question was raised as to what should be the action or advice of the State Board with reference to the advisability of making rivers which receive sewage the source of public water supplies. As a result of the discussion which followed, the Committee on Water and Water Supplies was instructed to make as careful and extended study as possible of this question and to report at a future meeting.

At a meeting of the Board July 9, the Secretary narrated some of the details relative to an outbreak of small-pox at the National Soldiers' Home, Togus, and the outbreak of varioloid

which was reported at Frankfort, but which was afterwards found not to be small-pox. Dr. Woodcock gave the history of an outbreak of small-pox at Bangor which, under unfavorable conditions, was limited to one case, and of his visits to Clifton on account of sickness there, erroneously reported as small-pox.

The Secretary reported that in some of the few towns and plantations where local boards of health have hitherto not existed, boards have been organized this year.

The following resolution, offered by the President, was adopted by the Board.

"WHEREAS, It is now an accepted fact that pulmonary tuberculosis is not only a dangerous communicable disease, but also that by measures of cleanliness and disinfection it may be in great measure controlled:

"*Resolved*, That local boards of health are hereby urged to unite to invite the co-operation of householders, physicians, and managers of hospitals and other public institutions in the direction of reporting to said local boards the occurrence of all cases of pulmonary tuberculosis, that proper instructions may be afforded all who have the care of such cases for disinfecting sputa, and rooms occupied by such patients, and all infected articles, and that valuable statistical information may be obtained."

At a prolonged meeting of the Board December 31, almost the whole time was devoted to a careful examination and consideration of the amendment and improvement of the public health laws, and to a hearing of Mr. Deasy of Bar Harbor, on the need of legislation providing for the preservation of the purity of water supplies. Further action relative to a bill which would be offered to the Legislature was left in the hands of the Committee on Legislation.

The question of the action of the Board with reference to the new treatment of diphtheria with anti-diphtheritic serum came before the Board; Dr. C. D. Smith was authorized and requested to visit Washington, New York, and Boston for the purpose of personally inspecting the methods of preparing the antitoxic

serum, and with a view of reporting to the Board the best and most trustworthy source from which the remedy may be obtained for use in our State.

The membership of the Board at the end of the year 1895, with the dates at which the term of each member expires, was as follows:

G. M. Woodcock, M. D., Bangor, term ending January 31, 1896.

C. D. Smith, M. D., Portland, term ending January 31, 1897.

A. R. G. Smith, M. D., North Whitefield, term ending January 31, 1898.

E. C. Jordan, C. E., Portland, term ending January 31, 1899.

M. C. Wedgewood, M. D., Lewiston, term ending January 31, 1900.

Professor F. C. Robinson, Brunswick, term ending January 31, 1901.

At the annual meeting, March 25, 1895, Dr. C. D. Smith was unanimously chosen President.

The following committees for the year 1895, were appointed by the President:

Finance—E. C. Jordan, F. C. Robinson, and the Secretary.

Circulars and Other Publications—A. R. G. Smith, G. M. Woodcock, and the Secretary.

Sewerage and Drainage and Disposal of Excreta—E. C. Jordan, F. C. Robinson, A. R. G. Smith, and G. M. Woodcock.

Ventilation—M. C. Wedgewood and E. C. Jordan

Summer Resorts—E. C. Jordan, M. C. Wedgewood, and the President.

Water and Water Supplies—F. C. Robinson, M. C. Wedgewood, and the Secretary.

School Houses and School Hygiene—G. M. Woodcock and the Secretary.

Sources of Animal Vaccine—C. D. Smith.

Quarantine—The President, M. C. Wedgewood, G. M. Woodcock, and the Secretary.

In addition to the usual standing committees, the President appointed the two following special committees:

On Legislation—The Secretary, the President, and M. C. Wedgewood.

On Experimental Work with Low-Cost Steam Disinfectors—The Secretary and F. C. Robinson.

At the meeting of March 25, the Secretary stated briefly the facts in relation to an outbreak of scarlet fever at Oak Grove Seminary, Vassalboro, and the methods of disinfection with bichloride solution and steam, by which the outbreak was very successfully stamped out.

The Secretary also reported to the Board the existence of a case of small-pox in South China, and the action which was taken relative to it.

The following resolution was adopted by the Board.

"*Resolved,* That it is the sense of the State Board of Health of Maine, that all inmates of prisons, reformatories, almshouses, hospitals, schools, and other public institutions be vaccinated immediately on admission.

"*Resolved,* That the Secretary is hereby instructed to transmit, at his discretion, a copy of the foregoing resolution to the official heads of such institutions in this State."

Dr. C. D. Smith, who, at the December meeting of the Board, was instructed to visit Washington, New York, and Boston for the purpose of investigating methods of preparing diphtheritic antitoxin and various questions connected with its use and sources of supply, made a full and interesting verbal report to the Board. It was voted that some of the results of Dr. Smith's enquiries be given to the public and to the medical profession through the columns of the *Sanitary Inspector.*

At the second quarterly meeting of the Board, June 24, one of the matters discussed was what instruction shall be given local boards of health in relation to their action when, under the new law, cases of consumption are reported to them. The Secretary was requested to issue a circular letter to the secretaries of local boards of health, advising them to make the attending physician the medium of communication between themselves and the persons or families who are reported as affected with tuberculosis; to supply physicians with Circular

No. 54, on the Prevention of Consumption; and not to make public the records of cases of tuberculosis or the notifications of such cases. It was also thought desirable to send a copy of this circular to the physicians in the State, as well as to local boards of health.

With the concurrence of the Board, the President appointed Dr. Wedgewood a fourth member of the Finance Committee.

The Secretary reported to the Board that since the last meeting, he had made a personal visit to South China in connection with the outbreak of varioloid in that town, to York Beach at the instance of various petitioners of that village, and to Island Falls on account of the continued prevalence of diphtheria at that place. Complaints of nuisances from various places, and the advice and action taken were also reported by the Secretary.

The President reported his further observations in Boston, on the preparation, collection, and use of diphtheria antitoxin since the last meeting of the Board. In the discussion which supervened, the members expressed the opinion that it is not desirable or practicable for the Board to take any steps toward furnishing, at the expense of the State Board, a supply of antitoxin for use in this State.

At the third quarterly meeting, November 18, the Secretary reported his visit to Rockland, October 24, to consult with the local board of health in regard to the outbreak of diphtheria in that city, and also reported the results of his conference with the local board of health and school board of Westbrook relative to the improvement of the sanitary condition of the Bridge Street school building in that city.

A large part of the time at this meeting was devoted to the discussion of the present status of antitoxin, its value as a prophylactic and curative agent, and what action now appears to be desirable on the part of our Board. The discussion disclosed that the opinion of the Board was that the collective reports of the use of antitoxin show unmistakably that it is an agent of great value in the treatment of diphtheria. It was voted that the Board use its influence to have agencies for the

sale of trustworthy antitoxin established at certain points in the State, and that the resident members in Bangor, Lewiston, and Augusta use their influence toward the establishment of agencies for its sale in their respective cities. It was also voted that the President be instructed to prepare one or more circulars relative to antitoxin and its use, to be printed and distributed among the physicians.

Some time was spent in the discussion of formic aldehyde and the existing evidence as to its value as a disinfectant. Professor Robinson was authorized by the Board to carry out a line of experimental work for the purpose of determining for the Board, the value of formic aldehyde in the actual work of disinfecting rooms and their contents, or for other purposes.

TUBERCULOSIS.

Of all the diseases propagated by infection, tuberculosis is by far the most destructive. What small-pox, cholera and the plague have done amid reigns of terror, tuberculosis does insidiously, but too surely. In this State pulmonary tuberculosis destroys more than 1,200 lives every year, the value of which in dollars mounts above the million mark, the time or labor which it wastes is another loss to the State fully as great, while the burden of sorrow, misery, widowhood, orphanage, and poverty is quite immeasurable by monetary standards.

Imposing such a burden upon the State as tuberculosis does, all practicable methods which hold forth reasonable hope of checking the spread of the disease or of arresting it in its incipiency should receive the earnest attention of legislators and the cordial support of every citizen.

It was in 1882 that Koch announced the results of his remarkable investigation into the cause of tuberculosis, that it is due to the presence and action of the *bacillus tuberculosis.* Since then he and other workers have determined pretty definitely the biology of the bacillus, the avenues through which it is introduced into the system, the pathways through which a local infection may be converted into a general infection, the excretions or discharges through which the infection leaves the

infected body, the significance of the physical conditions of moisture or of dryness of tuberculous sputum as regards its power for evil, the effect upon the bacillus of heat and of cold, of light and of darkness, the practical germicidal value of various chemical and other agents when applied to this germ,—in fact, the life history of the bacterial cause of tuberculosis has been so well and so widely studied that it is quite within bounds to affirm that only ignorance and the incubus of old-time impressions of the inevitable, stand in the way of putting those measures into general use which would effect a very marked diminution in the tuberculosis death-rate of the State within a decade. Such necessary measures, even when judged by strict scientific requirements, need not be harsh in the least degree. They would be eminently humane and kindly to the patient himself in preventing him from continually reinfecting himself, and to his attendants and the other members of the family in guarding others from infection by means of precautions few in number, but which require intelligent supervision.

The infectivity of tuberculosis is the most encouraging etiological discovery of modern times. It establishes the fact that the most destructive of the causes of death is a preventable disease.

For the purpose of teaching that pulmonary tuberculosis is largely preventable, Circular No. 54, "On the Prevention of Consumption," was printed for public distribution. This, the first circular published by a state board of health, teaching the bacillary origin of the disease and the modern methods of limiting its ravages, is reproduced on page 9. It has been printed in large editions and has been distributed through the hands of local boards of health, physicians, clergymen, teachers and others in numbers ranging from a few copies to a thousand or more, according to the number of families in the area of distribution.

Auxiliary educational work in the same direction has been done by the teachings of *The Sanitary Inspector,* the official bulletin of the State Board, and by the reports of the Board.

By act of the Legislature of 1895, pulmonary tuberculosis, or consumption was made a notifiable disease,—that is, the law prescribes that it shall be the duty of any physician who knows or has reason to believe that any person whom he attends or is called to visit, is affected with pulmonary tuberculosis, to report the same to the local board of health.

In any comprehensive plan of action to lessen the prevalence of consumption, a knowledge of the location of the cases of that disease is a prime necessity. The notification of the cases will enable the executive officer of the local board of health to assure himself that some one person at least in the infected family receives instructions pertaining to preventive precautions, and will also enable him to prescribe for the disinfection of some rooms that otherwise might serve as foci of infection.

Relative to what action local boards of health should take when cases of consumption are reported to them, the State Board issued the following circular letter.

AUGUSTA, Maine, July 18, 1895.

To Local Boards of Health:

Section 2 of Chapter 139, Laws of 1895, makes it the duty of physicians and householders to report cases of pulmonary tuberculosis, or consumption, to local boards of health. As to what action is best and the most expedient on the part of local boards when notifications of this kind are received, I am instructed by the State Board of Health to advise you as follows:

1. When a case of consumption, or pulmonary tuberculosis is reported to a local board by a physician, or when the case is attended by a physician, the physician should be made the medium of communication between the local board and the patient, or attendants, or family. That is, the attending physician should be depended upon to give verbally or by means of "Circular 54" the necessary instruction relative to the infectivity of tuberculosis and the precautions against this danger.

2. When a notification of a case of consumption comes from a householder or other person and there is no attending physi-

cian, the secretary of the local board of health should, at his discretion personally, or through the clergyman when the family is under clerical ministration, or through the friends of the family assure himself that the danger from dried tubercular sputum is understood and guarded against.

3. Keep "Circular 54, on the Prevention of Consumption" on hand and send copies of it to physicians when they report cases of that disease.

4. Reports of cases of tuberculosis should not be made public and the record of them should be kept in a book designed for that purpose alone.

In view of the fact that the mortality from tuberculosis is greater than that from any other disease, it is highly desirable that the general public be brought, as soon as possible, to appreciate the truth that consumption is a communicable disease, but that the faithful and intelligent observation of a few rather simple precautions will do much to lessen the prevalence of this scourge. If this disease afflicts a member of a household, just then is when this special instruction is needed; but as to whom shall receive it, and in what way, the attending physician is best able to decide.

By order of the State Board of Health,

A. G. YOUNG, *Secretary.*

Circular No. 54.

STATE BOARD OF HEALTH OF MAINE.

On the Prevention of Consumption.

That insidious disease which we call Consumption, Phthisis, or Tuberculosis of the lungs, is the most terrible destroyer of lives with which civilization has to contend.

Centuries ago consumption was regarded as an infectious disease in southern Europe, and extravagantly rigorous laws were in existence regulating communication with consumptive patients.

At the present time the fact of the infectiousness of consumption is firmly established in a scientific way, and enough is

known of the natural history of the infective agent, the *bacillus of tuberculosis*, and of the ways in which it is communicated to man, to enable us to lay down rules with more positiveness than hitherto for the prevention of the disease.

The source of the infection is twofold: from tuberculous animals to man, and from one human being to another. The tuberculosis of animals and human consumption are of the same nature.

From domestic animals there is danger of contracting the disease by the use of flesh, and especially by the use of milk from those which are tuberculous. Many children die in their earlier years from various tubercular diseases, tubercular inflammation of the brain, "consumption of the bowels," etc., and it is now assumed with much probability that the great majority of these die from infection received in the milk from tuberculous cows, or in that from mothers suffering from tuberculosis in some form.

By far the greatest source of infection, however, is consumptive human beings, but fortunately the ways in which the contagion is disseminated are but few, and by intelligent care they may be effectually controlled.

Practically, from the human source, we may consider the expectoration (the sputum) as the only serious danger. The consumptive sputum usually contains an abundance of the infection, the *bacilli*, and these microscopic organisms are found to be capable of retaining their vitality and their infectious qualities for a long while, even after the sputum has been thoroughly dried.

It has long been known that tuberculosis may be communicated to animals experimentally by feeding them with tuberculous matter, by injecting it into their tissues, or by causing them to breath air into which tuberculous sputum has been atomized. More recently, since the discovery of the *bacillus tuberculosis*, it has been found that the bacilli may be cultivated upon artificial media, and that when thus cultivated and freed from all other matter which might possibly be infected, tuber-

culosis may still be communicated to animals in the ways which have just been mentioned, and with great certainty.

Experiments, the conclusions from which can hardly be questioned, have shown that the breath of the consumptive patient is not infectious, *and that the same may be said of the sputum so long as it remains moist.*

Another line of investigation has proved that *the careless consumptive patient is a focus of infection, and a danger to all persons who come much in proximity to him,* especially to those who dwell in the same rooms with him.

The reason of this is that the expectoration of the patient, spit upon floors, carpets, pocket handkerchiefs, or clothing, becomes dried and pulverized and, floated in the air, still contains the infectious germs and cannot be inhaled without great danger.

Though infection may be regarded as the principal, *the essential* cause of consumption, there are nevertheless various untoward influences which have much to do with increasing the death-rate from this disease, and they should never be disregarded. The most important of these are the breathing of impure air, particularly that of unventilated sleeping rooms and living rooms, the use of food not sufficiently nutritious and dwelling upon a damp soil.

How far heredity is a cause of consumption is, from the nature of the question, hard to determine. Since the infectiousness of the disease has been shown, many family groups of consumption, "house epidemics," may fairly be assumed to be from infection rather than from hereditary influence. Some able writers would discard heredity as one of the causes of tuberculous disease, but others, more conservative in their views, while believing that direct inheritance is rare, think that certain peculiarities of constitution, favoring susceptibility, are transmissible from parent to child.

RESUME.---1. Tuberculosis is an infectious disease. 2. The breath of the consumptive patient is not infectious. 3. The sputum is harmless so long as it remains moist. 4. Tuberculous infection is produced, in the great majority of

cases, by the inhalation of dried and pulverized tuberculous sputum.

PREVENTION.

To restrict the spread of infection.

It should be impressed upon consumptive patients and other persons living with them, that *the sputum (what they cough up) is dangerous and must be properly disposed of.*

The sputum should be received in a spit-cup or spittoon containing a little water or disinfecting fluid, and must never be spit upon floors, carpets, or received in handkerchiefs. If a disinfecting solution is used, corrosive sublimate is unsuitable, chloride of lime is efficient but irritates the air passages, carbolic acid (Solution E.) with 5 per cent of tartaric acid or hydrochloric acid, will be the best disinfectant generally available.

If occasionally it is necessary to have handkerchiefs or cloths soiled with the sputum they should be boiled as soon as possible and before drying.

The spittoon should be of such shape that the sputum may easily fall into the water without soiling the sides of the vessel. For patients not able to sit up, a small spit-cup with a handle should be used. When flies are present, it should be covered.

Spit-cups and spittoons should be emptied and cleansed often with boiling water and potash soap. When the house has a drainage system, the contents may be poured down the water-closet or slop-hopper; when it has not, they should be buried in ground which will not be turned up soon.

The sputum should not be thrown out upon the surface of the ground near inhabited places, nor on manure heaps, nor where animals may get it, nor where it may soil animal food.

Boxes filled with sand or sawdust should not be used. Cheap wooden and pasteboard spit-cups are now on the market, one of which may be burned daily or oftener with its contents as a convenient way of disposing of the sputa.

A pocket spit flask of small size has been devised, which may be used while away from home.

The floors, woodwork and furniture of rooms in which consumptive patients stay, should be wiped with a damp cloth, not dusted in the usual way.

The patient's clothing should be kept by itself and thoroughly boiled at the washing.

The patient should be made to understand that, in neglecting these measures, he is imperiling his friends, and at the same time diminishing very much his own chances of recovery by re-infecting himself with the inhalation of his own dried and pulverized sputum.

After a death from this disease has occurred, the patient's room, clothing, and bed should be disinfected. For this purpose boil all bed and personal clothing, or disinfect them when practicable in a steam disinfector; wash furniture, woodwork, walls, and floors, with carbolic acid solution (Solution E.), and thoroughly expose the rooms to light and air.

If raw milk is used as food, especially if it is to be given to children, an assurance should be had that the cows which produce it are perfectly healthy and subjected to healthful treatment.

When there is any doubt as to the health of the cows which furnish the supply, the milk should be boiled before use.

Thorough cooking will remove all danger of tuberculosis through the medium of the meat supply.

Tuberculous mothers and those inclined to consumption should, under no conditions, suckle their babies.

To guard against contracting the disease.

By observing the rules which are expressed and suggested in the foregoing, the principal, if not all danger of infection may be avoided.

Whatever has a tendency to undermine the general health increases the susceptibility to the infection and diminishes the power of recovery from incipient tuberculosis.

A fact abundantly shown in the dissecting room is, that many persons dying of other diseases, have had tuberculosis and have recovered in its early stages.

This tendency to recover is greatly strengthened by the habitual breathing of pure air. Means should be provided for the abundant ventilation of inhabited rooms, particularly of sleeping rooms, school-rooms, and churches.

The open air treatment of consumptives and those who are threatened with tuberculous disease, has given much better results than any other. Particularly in Germany, and to some extent in this country, such treatment has been systematized in "sanitaria" for consumptives. There the patients have the advantage of a regular life, nutritious food and such exercise as they can bear without fatigue; but the chief curative agent is an abundance of fresh air. Even in the coldest of winter weather, patients, after a period of gradual habituation, and always guided by the judgment of the physician, pass the whole day walking in the open air, or sitting or lying on resting places wrapped comfortably in blankets. Usually no claim is made for advantages of climate. *An abundance of pure air is the all important thing.*

DIPHTHERIA.

The average number of deaths in the State from diphtheria and diphtheritic croup has been 167 for the three years for which the reports have been compiled. This number of deaths is far below that from tuberculosis, but under conditions such as existed years ago in the State, or with a gross relaxation of our present continual vigilance, it would be quite within the malignant possibilities of this disease to equal now and again the destructiveness of tuberculosis, and to far surpass it in the consternation and panic which would accompany its fell work. Under existing conditions, the presence of the diphtheria contagion is always a grave danger; and every form of it demands quick action in stamping it out in its incipiency, by prompt notification of local boards of health, by isolating the sick from the well, by disinfection, and otherwise in accordance with the requirements of the law.

Quite frequently an opinion honestly held as to the nature of a throat disease permits destructive outbreaks of diphtheria when the child, with what appears to be a simple sore throat, is allowed to commingle with other children. The only safe way when there is any question at all as to their diphtheritic character, is to prevent the association of such cases with other children,

and by all means to keep them from the public schools until it is proved that they are non-diphtheritic, or until the final disinfection which is indicated by a diagnosis of diphtheria or by doubt.

The non-observance of these precautions was the cause of a serious outbreak in Rockland, the history of which is partially narrated in the following report of the Secretary to the State Board of Health:

Wednesday, Oct. 23, in the forenoon, I received a telegram from the secretary of the local board of health of Rockland to visit that place on acount of disputed diagnosis. Taking the night Pullman, the first available train, I was there the morning of the 24th, ready to consult the board.

To that date there had been 22 cases of diphtheria with 3 deaths. I found that nearly all of the cases of diphtheria had been in children who had attended the McClain School Building, and it was learned that children from families in which there had been cases of throat disease had attended school for the reason that they had not been considered cases of diphtheria, or had not been recognized as such by the attending physician.

The cases of disputed diagnosis were in the House of the Good Shepherd, an institution under the charge of the Episcopal church, for the reception and care of orphans until homes can be found for them elsewhere.

The building is an old one, formerly used as a tenement house, situated on low ground near a brook and presumably on ground which had been saturated with filth for years. The members of the local board who accompanied me stated that considerable cleaning up had been done within a few days, but a privy vault was found which was in bad condition and so situated that the abundant emanations from it must necessarily penetrate the rooms more or less. The matron or deputy matron who was present stated that this privy is used only by the servants. It apparently had not been cleaned out for a long time and was in a position where it would be quite impossible to renovate and run it in a passably satisfactory way.

The building is heated with two hot air furnaces and the fresh air boxes for each are insufficient in size, which fact is particularly true of one of them, the area of whose fresh air conduit was much smaller than the combined area of the hot air pipes which go from the furnace to the various rooms.

The building is overcrowded. Some of the rooms used as dormitories which are approximately twelve by fifteen feet, had five beds; others four.

I learned that there had lately been twenty-five or twenty-six cases of sore throat among the little occupants of the building. None of these had been reported to the local board of health by the attending physician until the death of one of them occurred, then the local board of health visited the place, gave directions in regard to sanitary management of the cases in the institution and left them with the attending physician. Not hearing from him in due time, they again visited the place, found other cases of sore throat and that the aggregate number had reached twenty-six and that one was unmistakably diphtheria. When this case was seen by me, the false membrane was apparently coming off, but one tonsil was still plentifully covered with exudate and quite a patch of it was present on the left lateral posterior wall of the pharynx. This case presented the appearance of a genuine case of diphtheria, and I had no hesitation in calling it such and thus agreeing with the unanimous opinion of the three members of the local board.

The local board told me that children from this institution attended the McClain School for four or five days and presumably a week after the outbreak of sore throat occurred in this building.

At a subsequent conference of the local board of health with the secretary of this board, the physician who has charge of this institution was sent for and, acquiescing in the judgment of the local board that there had been cases of diphtheria in the institution, promised to report faithfully and promptly in the future every case of sore throat which might occur whether he believed it to be diphtheria or not.

My recommendations regarding this institution were that the privy be abolished, and that a water-closet be put in for the use of the servants in addition to the two water-closets which already are in use; and that a commodious fresh air box be put in for the furnace which needed it the most, and that instead of running it beneath the floor of the basement, have its inlet start near the ceiling of the basement and that its course be overhead until it reaches the vicinity of the furnace.

It was further recommended to the local board that the number of children received in the institution at one time be not more than twenty-five, and that, unless the sanitary improvements which were recommended are carried out, it would be preferable to restrict the number to twenty. The present number in the institution is twenty-eight; the largest number present at one time has been thirty-two.

I found that the local board of health had closed the schools for a period of two weeks, that it had interdicted public dances for the present, and that they had been disinfecting the McClain school house and another which stands near it, first by sulphur fumigation and then by thorough scrubbing with corrosive sublimate solution. These efficient measures were of course approved by the Secretary of the State Board with the recommendation that the disinfection process be applied to the Episcopal church in which the Sabbath school had been attended by children from this House of the Good Shepherd in which the outbreak of sore throat had appeared.

The local board of health of Rockland richly deserves credit for hard and efficient work after they were aware of the danger, but various foci of infection had been established in the city and the board worked under disadvantageous conditions. Among the other lives sacrificed was that of the lamented Dr. Albee, chairman of the local board, who contracted the disease while working for the safety of the public.

DIPHTHERIA ANTITOXIN.

The investigations relating to the preparation of diphtheria antitoxin as a prophylatic and as a curative agent, and the gradual extension of the use of it have been watched with keen interest by the Board. In the latter part of 1894, the clinical reports of the use of antitoxin in diphtheria indicating an encouraging degree of success, Dr. Chas. D. Smith, President of the Board, was authorized and requested to investigate the methods of preparing the antitoxin and the cost of equipping and maintaining an establishment for the production of the antitoxic serum in quantity sufficient to supply our own State, or of arranging for a special supply to meet our needs. He was asked to let his enquiry include facts, so far as obtainable, bearing upon the value of the antitoxin, the comparative trustworthiness of the preparations offered by various houses, and the prevailing dosage and the technique of its administration. Through the courtesy of the Marine Hospital Service Department, Washington; of Dr. Cyrus Edson, health commissioner of New York; of Dr. S. L. Durgin, President of the Board of Health of Boston; and of Dr. H. C. Ernst, of the Harvard Bacteriological Laboratory, their respective laboratory methods were inspected and otherwise many kindnesses were shown which very much facilitated the investigation.

In the early part of the following year, Dr. Smith made an interesting verbal report to the Board. After full consideration of the matter it was deemed inexpedient and beyond the means of the Board to effect a gratuitous supply of antitoxin for use in the State, but arrangements were subsequently made with druggists at easily available points to keep a supply of trustworthy diphtheria antitoxin on hand.

The report of Dr. Smith and later reports, with very few exceptions, bear testimony to what is now a generally accepted truth that, as a curative agent in the treatment of diphtheria, antitoxin is of great value. That some of the parts of Dr. Smith's report might become immediately available, the following, which he prepared at the request of the Board, was published in the *Sanitary Inspector:*

DIPHTHERIA AND ANTITOXIN.

By CHAS. D. SMITH, M. D., President State Board of Health.

There fortunately exists no need to explain what diphtheria is. The time has been reached when its contagiousness has been demonstrated, its danger exposed, and its mode of origin and plan of attack made plain. We are now justified in concluding that the disease is the result of absorption into the blood of a poison generated by the growth of certain micro-organisms, which find a congenial soil for development upon certain mucous surfaces, preferably those of the throat, nasal passages or larynx. So widespread is the fear of this disease, and so fatal have been its attacks upon child life, that any plan of treatment which offers protection from contagion and a cure for the malady, is quickly sought and employed by the medical profession and eagerly received by the public.

It is the purpose of these few words to explain for the benefit of those readers of the "Inspector" who are not of the medical fraternity, what antitoxin is, how it is made, how it is used and why we may be encouraged to hope that its present promise will be fulfilled.

Diphtheria antitoxin is the serum, or watery part of the blood of a horse which has been rendered proof against the poison of diphtheria by repeated and long continued inoculations with a virulent form of the diphtheria poison in successively increasing doses.

The method of treatment which involves the use of this material has received the name of the "Serum Therapy," and will, it is probable, prove of value in other infectious diseases. Its application is the result of a long series of experiments by eminent German and French scientists, to prove the theory that the blood of an animal rendered immune against infectious disease, must contain something which, if introduced into the blood of another animal sick with the same disease, will counteract or modify its ill effects. The process by which this remedy is produced is one requiring accurate knowledge of the natural history of the germ which produces the diphtheria poison, and skill in chemical manipulation. Great care must be exercised during all the many essential steps to render absolutely certain the exclusion of any other germ than that peculiar to diphtheria. The first step is to produce a quantity of the pure unadulterated diphtheria poison or toxin. A small portion of diphtheria membrane or a little of the nasal discharge is added to some material suitable for its growth, usually bouillon, and the bouillon is

placed in an incubator and kept at a temperature of about ninety-nine degrees F. for twenty-four hours. It will then be found to contain great numbers of the micro-organism of diphtheria.

Several flasks of special design are then partially filled with bouillon, and subjected to a degree of heat sufficient to kill any germ that may be present. Then the contents of each flask are inoculated with the infected bouillon and placed in an incubator so arranged as to insure the passage through the flasks of a constant current of moist air. The object of this arrangement is to hasten and promote the development and death of the diphtheria bacilli, by which the characteristic toxin is set free. These inoculated flasks are kept in the incubator under these conditions, at blood heat for three or four weeks. At the end of this time the bouillon is filtered through a porcelain filter into sterilized receptacles, so as to remove all the dead bacilli, leaving only a solution of the chemical poison. Its virulence is then tested by inoculating with it, guinea-pigs of known weight and ascertaining the minimum amount required to kill in twenty-four hours. This is about three drops for a guinea-pig weighing about a pound.

Next comes the process of manufacturing in the blood of the animals selected, the material which will neutralize the diphtheria poison, and this material is the antitoxin in solution in the serum of the blood.

The animals used are horses, experiments having shown them to be best adapted to this purpose.

It is only necessary that the horse be healthy, and the first step is to prove him free from suspicion of glanders or tuberculosis.

This having been done, a very small quantity of the toxin, say fifteen drops, is injected under the skin just back of the shoulder.

This is usually followed within twenty-four or forty-eight hours by marked inflammation and general febrile disturbance. After these have subsided the injection is repeated at gradually decreasing intervals, and in constantly increasing doses, until at the end of twelve or fourteen weeks the animal is able to withstand injection of a quantity many times larger than the initial dose, as much as six or seven ounces, with only a little local swelling as the result.

By this time the horse's blood contains a large amount of antitoxin and it is drawn from a vein in the neck of the animal into sterilized jars, allowed to coagulate and placed in a cool place for twenty-four hours, by which time the watery part or serum will have separated. Two or three quarts are the result

of a single bleeding. This serum is the fluid sold in the stores and called antitoxin.

The strength of the serum is tested upon guinea-pigs. It is ascertained how much will be required to protect known weights of guinea-pigs against an inoculation of virulent diphtheria poison.

The label "1 to 50,000" upon the little bottle of antitoxin expressing its strength, means that one gram (15 grains) will protect 50,000 grams (750,000 grains) of guinea-pigs.

The amount required for protecting a certain number of grams of humanity is easily a matter of approximate reckoning.

This serum may be kept two or three months without losing its efficacy, and should be kept from the light and at an even temperature.

It is frequently asked, is the injection of this fluid attended by any risk. It may be said in answer, practically none. Beyond a little swelling at the point of injection, which speedily disappears, there are no local manifestations. It has sometimes happened that an eruption like nettle rash has appeared after the administration of the serum, and rarely slight pain and swelling in the joints, but these are attributable to the mechanical irritation from the use of large amounts of weak serum and not to any septic influence of the serum itself. There has not been any increase of kidney complications.

Do the results from its employment in diphtheria justify its use? To this the answer must be positively affirmative.

It must be remembered that antitoxin is not claimed to furnish either an infallible preventive or cure. That its administration in Europe and this country has been attended by a most remarkable improvement in the death-rate, a reduction of nearly fifty per cent., must be admitted.

It is true, not all of the cases recover with its use. It is equally true that facts may yet be developed which will neutralize our present sanguine expectations. These facts are not yet in evidence, and if we have not found in antitoxin a specific, we have found an agent which undoubtedly limits the progress of the disease by preventing the increase of the germs, and seems to confer immunity when administered to those who have been exposed to infection.

Doubt has been thrown upon the value of the estimates of the power of antitoxin because it has not been the sole remedial agent employed. This contention is illogical, because, in most cases of diphtheria the infection, after its inception, is mixed, that is to say, the patient suffers, in addition, from the absorption of poison generated by the growth of certain pus-producing

micro-organisms, upon which the serum has no specific influence, hence there remains the same necessity for generous nutrition, heart tonics and other supportive measures as before antitoxin was known.

It may be said in this connection, that the use of strong germicidal local applications seems to interfere with the best results of the serum treatment. Such applications should be solutions of the milder agents like boric acid or chlorinated soda.

When administered as a preventive to persons exposed to the disease, the dose will vary from twenty drops for a child under two years, to a dram or a dram and a half, above the age of ten. The protective influence probably does not last over six weeks, so in the case of continued exposure, the dose should be repeated at the end of a month.

Antitoxin given to cure diphtheria secures its best effects the earlier its use is begun. A dram or a dram and a half should be used for the first injection, and repeated in even larger dose (up to five drams) in from twelve to twenty-four hours according to the effect upon the formation of the membrane, the temperature, the behavior of the kidneys and heart, and the glandular swellings.

These doses are based upon the employment of the strong antitoxins like Aronson's and Behring's, having an immunizing power of at least 1 to 50,000.

The injections may be made with any syringe having a capacity of two to three drams, fitted with hypodermatic needles and capable of being sterilized. The injection should be made into the tissue immediately beneath the skin, either upon the flank, the thigh, or between the shoulder blades—the skin having been previously sterilized.

In the great majority of cases thus far reported, the effects have been immediate and noticeable, and among all the evidence none tells any more than that given by Virchow, at the Berlin Medical Society, Dec. 5, 1894.

The treatment was begun in hospital in March, 1894, and during June and July *all* diphtheria cases were treated with serum. Beginning with June, during the first eight weeks 63 cases were treated, with eight deaths. During the next seven weeks treatment was carried on *without* serum, the supply having ceased, by reason of the death of some of the horses from which the supply was derived. There were treated 109 cases, with 55 deaths, an alarming increase in mortality.

A supply of serum was obtained again, and during the next six weeks there were treated 81 cases with 12 deaths.

There were treated from March to December in all 533 cases, 303 with serum with a death-rate of 13.2, and 203 without serum with a death-rate of 47.8.

These figures are remarkable and are also reliable, since the diagnosis in every case was confirmed by the demonstrated presence of the diphtheria bacillus.

Statistics thus far obtained from all sources in this country, while not showing such a surprising drop in the death-rate as those quoted, yet indicate a reduction of nearly or quite one half.

Extension of membrane to the nasal passages or larynx has become rare, and this fact alone is strong evidence of the value of this new remedy, for the vast majority of these cases without the serum treatment are fatal.

It is not yet possible to fix accurately and beyond question the range of usefulness of this valuable agent. Time and the comparison of widely gathered facts and figures can only accomplish this.

The statistics from private practice, will hardly have the force of those compiled by the hospitals and public health boards of large cities unless, as in their practice, the diagnosis is confirmed in every case, by the demonstration of the Klebs-Loeffler bacillus. It is probable that without this procedure, the antitoxin will gain credit for cures, as it frequently has, when a microscopical examination may show a non-infective nature of the membrane.

With such possibilities, and such testimony in its favor, antitoxin must be regarded as a safe and legitimate agent to be used in cases of actual or suspected diphtheria; but the article must be of guaranteed and unquestioned purity and its immunizing power accurately known.

We may be sure that the weak points of the serum therapy will not escape the scrutiny of scientific observers, and that it will be fairly and justly estimated by its results.

Thus far, the cost has been considerable, and the regularity of the supply uncertain, but there is every reason to believe that in the immediate future the supply will be abundant, of moderate cost, and at the same time its quality will be as reliable as at present.

The writer desires to acknowledge his indebtedness for opportunities to observe the process of manufacturing the toxins, and the various phases of the antitoxin application, to Past Asst. Surgeon J. J. Kinyoun of the U. S. Marine Hospital Laboratory at Washington, and to Doctors Biggs and Beebe of the New York City Board of Health, and to Doctors Ernst and McCol-

lum of the Harvard Bacteriological Laboratory, who have accorded the representative of this State Board every opportunity for a practical study of the present status of the bacteriology of diphtheria.

ON THE USE OF DIPHTHERIA ANTITOXIN.

AUGUSTA, MAINE, December 26, 1895.

Dear Doctor:—

At the request of the State Board of Health, the following circular letter on the use of Diphtheria Antitoxin is prepared by Dr. Charles D. Smith, President of the Board, and is sent to you from this office.

A. G. YOUNG, *Secretary.*

The February number of the *Sanitary Inspector*, the official bulletin of this Board, contained a paper upon "Diphtheria and Antitoxin" in which were set forth some facts relative to the serum and the technique of its administration.

So general has its use become in all our larger communities, and so favorable are the collective reports of its action, that the Board deems itself warranted in urging, by this circular, its more extensive employment by the medical profession of this State, and for the following reasons:

In by far the most comprehensive paper yet presented upon this subject, Professor William H. Welch, of Johns Hopkins University, states that the mortality of diphtheria since the introduction and systematic use of this remedy, has suffered a reduction of from 50 to 60 per cent. compared with the recognized average before antitoxin was used. His statistics are compiled from all accessible sources, both in this country and abroad.

At the present time the evidence of clinicians the world over is overwhelmingly in favor of the curative effect of antitoxin upon diphtheria.

It is not claimed that all cases are cured by it. Many are complicated by septic conditions upon which antitoxin exerts no influence. The results of secondary septic infection it cannot be expected to remove.

It will, however, neutralize the poison of diphtheria and if administered early will, in the vast majority of cases, prevent the occurence of these septic conditions.

Certain other facts relative to its action are now as well established as any facts of therapeutics need to be to render them acceptable.

Its existence is the result of years of laborious experiment in the study of immunity.

There are scientific and demonstrated reasons for the power claimed for it. It is, for example, capable of absolute proof, that a certain quantity of the antitoxin will destroy the virulence of a certain known amount of diphtheria toxin.

It has been demonstrated, over and over again, that in suitably proportioned doses it can limit the extension of membrane and materially alter the character of systemic poisoning.

Its practically innocuous nature has been proved in over 100,000 injections.

Almost universal testimony of the most reliable character is to the effect that by its use the frequently resulting paralyses are less in number, there are fewer cases of nephritis, less albuminuria, and a greater freedom from the other and more fatal complications of laryngeal obstruction and broncho-pneumonia.

The great majority of cases of diphtheria which have the exudate confined to the tonsils or soft palate recover, if the membrane remains thus limited for forty-eight hours, whatever the treatment.

The dangerous cases are those in which there occurs invasion of the pharynx, nasal passages, the larynx or trachea. Most of these without antitoxin and in spite of the best treatment, die.

It is confidently believed that the timely administration of antitoxin will prevent invasions of these areas, and often arrest the progress of the disease when they have become involved.

The earlier it is employed, the greater is the probability that such immunity will be secured. This one fact is reason sufficient to urge its use in every case of diphtheria, not alone to cure an existing condition, but to prevent the occurence of more serious trouble.

There are sometimes trivial inconveniences of soreness about the point of injection, or a rash, but they are of little moment and may be safely ignored.

The extent and severity of the disease is the best guide to dosage, modified to a slight degree by the size of the patient and the period of the sickness.

For mild cases, with exudate limited to the soft palate and tonsils, a single dose of 800 units or 8 c. c. of Behring's Standard No. II. Solution, or the same quantity of Aronson's (Schering's), is recommended, or 15 c. c. of a 1 to 50,000 of Roux's. For children 10 to 15 years of age, or for adults, 1,000 units or 10 c. c. should be given. Larger doses of a stronger serum, No. III, are to be given to the extent of 10 to 15 c. c., in proportion to the

severity of the symptoms or the approach of toxemia, or laryngeal involvement.

If, at the end of twenty-four hours, there is no abatement of symptoms, another 10 to 15 c. c. should be given. Usually the good effects are apparent within that time.

If there is, after some days, a return of the exudate, repeat a moderate dose. If these doses are not efficacious, there will be little use in continuing or increasing them.

Antitoxin acts by assisting nature to recover from the effects of the diphtheria poison. It neutralizes the effect of this poison, but does not kill the micro-organisms which produce it, hence, local treatment which may have this desired germicidal effect, and generous tonic and supportive treatment to combat sepsis from microccocci which are almost always present are just as important as if no help from antitoxin were to be expected.

Immunity against the disease may be secured for those who have been exposed to its infection by an injection of from 100 to 200 units (from 1 to 2 c. c.). This is lost at the end of about four weeks. If its continuance is desired the injection must be repeated.

The injection is to be made *beneath the skin*, not into the muscles. The site of puncture is unimportant provided the skin is loose enough to be easily raised.

Any hypodermatic syringe, which, with its needle, can be easily sterilized by boiling water, will serve, if of sufficient capacity for the required dose.

The supply of antitoxin is now ample, and so far as can be determined is of proper quality. The products of different laboratories apparently differ only essentially in their comparative strength. It is still a matter of regret that the price remains at a high figure.

The Board is able to announce that a constant supply will be found at the following places, and may be ordered by telegraph or telephone, if haste is desired:

Houlton, H. J. Hathaway; Bangor, Ara Warren; Augusta, Chas. K. Partridge; Lewiston, D. W. Wiggin & Co.; Rockland, Thos. A. Donohue; Portland, Geo. C. Frye & Co.; Schlotterbeck & Foss.

TYPHUS FEVER AT BAR HARBOR.

The following is the report of the Secretary to the Board on a visit to Bar Harbor. The rarity of outbreaks of typus fever in this country, particularly away from the chief immigration ports, and the failure to get any clue to the origin of the contagion, justified hesitation in calling the disease typus fever.

On the morning of December 25, 1895, I arrived at Bar Harbor in answer to a telegram received from the local board of health the day before. I was met at the landing by the secretary of the local board of health and by Dr. Douglas, resident physician of the village.

I was then told that since September there had been an outbreak of a disease which, at first, was supposed to be typhoid fever but which, later, the attending physician had been suspicious that it might be typus fever. The statements of Dr. Douglas, physician who has attended the cases, were to the following effect:

John Young, thirty-two or thirty-three years old, had been on Duck Island, four or five miles out to sea from Bar Harbor, all summer, lobstering, leaving the island at short intervals only, to dispose of his catch. He came home, September 8, sick. He was sick about five weeks with what was supposed to be typhoid fever. The attending physician ceased his visits October 26. No eruption was noticed by the physician during his attendance upon Mr. Young. For the full history of this case see "General Clinical History of the Cases."

Mr. Young lived at the village of Otter Creek, in the town of Eden, about five and a half miles from Bar Harbor.

SECOND CASE.

Josie Young, a little girl of six years, became sick November 6, about one week after her father's recovery. She died at the end of the eighth day. Upon the sacrum and ilia eighteen or twenty superficial sloughs, about an inch in diameter, (?) occurred on the third or fourth day. Some of these coalesced. The discharges from the sloughs were very offensive and the disagreeable smell of the room was increased by the offensive breath of the patient. A few of these superficial sloughs of smaller size appeared upon the mammary region.

At the first visit, which was about twenty-four hours after the beginning of her sickness, she was found to have been delirious all night; the tongue was then swollen, and the patient was in

a stupor; took medicine mechanically. Two days after the first visit the tongue was black and dried; countenance expressionless, dusky red.

THIRD CASE.

Albert Young, thirteen years of age. Temperature 104 degreees for four or five days; then it declined to 101 for six days or so, and the attending physician believed him to be convalescent. Then one morning he was found delirious, picking at the bedclothes; recognized nobody. This case had the circumscribed sloughs upon the sacrum as in the second case. Death occurred on the fourteenth day.

FOURTH CASE.

Mrs. John Young, about thirty-two years of age. November 28 she complained of "sore in the ear" and earache. A mastitis was also present but, under treatment, no suppuration occurred. She was nursing an infant about one year old, but upon the advent of the sickness the child was weaned. The next day stupor; recognized no one from then until her death on the eleventh day. Near the last of the disease, two small ecchymotic spots appeared on the inside of the calves, about twice the size of the head of a pin. No other eruption noticed; might have been other spots but did not look for them.

FIFTH CASE.

The remaining four children, during the illness of Albert and the mother, and while the disease was supposed to be typhoid fever, were brought to the village and put under the care of a Mrs. Higgins.

Upon his departure, Frankie Young, ten years of age, kissed his brother Albert who was then sick and in a semi-coma. Eight days after kissing his brother and leaving him, he was attacked. The onset was sudden, flushed face, etc. The next day he was better; the next day after that, worse, with a temperature of 104. He was attacked December 12. December 22, in the evening, he was again better with a declining temperature, and at the time of my visit on the 25th, appeared to be in a fair way to recover. This was the only case sick at the time of my visit.

General Clinical History of the Cases.—In all of the cases the onset of the disease was sudden.

In all of the cases constipation instead of diarrhea.

In all of the cases abdomen flat; no tympanites; no tenderness or gurgling in the ilium.

In all of the cases discharges very dark brown or black; not yellowish in any of the cases.

In all of the cases rapidly supervening stupor and delirium. Face flushed, dusky red, although the complexion of all of the patients was very light in health and with face very freckled.

Countenance expressionless, like a lump of clay.

Tongue swollen and rapidly becoming dark; dry.

Temperature rising rapidly (second day) to 104 and in some of the cases to 105 in the axilla. The morning temperature in some of the cases was higher than the evening temperature. A higher evening temperature has not been characteristic of the cases.

Autopsy.—In the third case, about twelve hours after death the autopsy was held. The following conditions were noted:

Hypostatic congestion of the lungs; very dark.

The blood fluid, very dark.

Heart soft and flabby, yet would not tear.

Spleen moderately enlarged, dark in color.

Small intestines red; injected, but apparently no inflammation.

Large intestines pale.

In the lower part of the small intestines nothing characteristic; no ulceration, no inflammation, no swollen Peyer's patches or other glands.

In the pericardium one-half to one ounce of yellow, or straw-colored, thick, sticky liquid. No examination of brain or spinal cord was made.

The statements of Dr. Douglas in regard to the clinical history were corroborated by Dr. Morrison.

Dr. Averill of Bar Harbor assisted at the autopsy and upon submitting my notice of Dr. Douglas' statements to him, he said that they were correct with the exception that he thought that the time which had elapsed, after the death before the autopsy was made, was not so long as stated by Dr. Douglas, and he was not sure in regard to the quantity of fluid found in the pericardium; thought it might not have been an ounce or even one-half of an ounce, but he corroborated the statements as to its color and consistency.

Before the fifth case occurred, suspicions had been aroused as to whether the cases had been typhoid fever or not, and Frankie, upon the first indication of illness, was promptly removed to the isolation hospital, or pest-house, in "Witches' Hole." The house of Mr. Young, as it was of very little value, was burned to the ground for the purpose of disinfecting the premises, and furthermore, the local board of health appeared to be doing everything possible to save the public from danger.

SMALL-POX AND VACCINATION.

During the early part of the biennial period for which this report is made, small-pox was widely distributed through the United States, and the vigilance of State and local boards of health was taxed to prevent the appearance of the disease and to keep outbreaks from extending. In the tenement house districts of several of the larger cities of the country, epidemics of considerable extent and duration were due to insufficient vaccination, and the difficulty in securing vaccination was the cause of a serious prevalence of the disease in the mining regions of another state. Several outbreaks occurred in Maine, but in each case the disease was confined to the primary case or the first household.

Under the new law authorizing local boards of health to offer free vaccination, many citizens of our State have been vaccinated, but it is to be regretted that the sphere of the protective influence of vaccination is not more nearly universal.

In every town vaccination of the inhabitants should be regarded as an indispensable security, not only to life and health, but against the financial calamities that often accompany epidemics.

The law requiring the vaccination of all operatives in and around those paper mills which use rags is a salutary one. Quite frequent outbreaks of small-pox originating from infected rags formerly occurred, but since the law went into effect, seven years ago, no case of small-pox has appeared among the employees of those mills.

Water Analyses.

ANALYSES OF SAMPLES OF WATER—Expressed in Parts per 100,000.

Number of analysis.	Origin of Sample.	Date of collection.	Total solids.	Loss on ignition.	Hardness.	Chlorine.	Free ammonia.	Organic ammonia.	Nitrites.	Nitrates.
		1894.								
927	Well, Farmington	January 18,	14.4	5.4	5.29	2.2	.000	.000	Very slight trace.	Much.
928	Spring, Farmington	January 15,	27.2	16.2	9.57	2.4	.003	.005	Very slight trace.	Very much.
929	——, Caribou	....	5.8	3.6	4.57	.2	.003	.006	None	Heavy trace.
930	Well, Durham	February 11,	26.6	13.2	6.43	5.6	.003	.002	Much	Very much.
931	Spring, Lewiston	February 25,	5.8	2.8	3.90	.4	.006	.005	None	Trace.
932	Well, Standish	March 11,	28.0	9.2	9.57	5.6	.009	.005	Much	Very much.
933	Spring, Dixfield	March 28,	3.2	1.2	1.27	.1	.000	.002	None	Very slight trace.
934	Well, Bangor	June 11,	38.2	15.4	11.80	10.8	.004	.003	Trace	Much.
935	Well, Gorham	July 19,	21.6	9.2	5.00	1.0	.003	.004	None	Heavy trace.
936	Well, Gorham	July 19,	23.0	2.8	6.0	.6	.000	.000	None	Trace.
937	Well, Mt. Vernon	June 13,	......	......	2.60					
938	——, Dover	....	5.4	4.0	1.95	.2	.003	.011	None	Heavy trace.
939	Well, East Hampden	August 10,	5.8	2.6	3.25	.4	.001	.002	Very slight trace,	Heavy trace.
940	Well, Bowdoinham	August 20,	16.0	7.2	7.43	2.8	.000	.007	Trace	Slight trace.
941	Pond, Mechanic Falls	August 18,	5.0	4.0	1.95	.2	.003	.024	None	Very slight trace.
942	River, Mechanic Falls	August 18,	3.6	2.2	1.95	.2	.001	.011	None	Very slight trace.
943	Spring, West Sidney	August 20,	4.8	2.2	1.69	.2	.000	.000	None	Slight trace.
944	Well, Wilton	August 27,	35.4	17.4	8.88	4.2	.001	.005	Trace	Much.
945	Pond, Hallowell	August 28,	3.8	1.0	1.56	.2	.002	.015	None	Very slight trace.
946	Lake, Hallowell	August 28,	3.6	3.2	1.95	.2	.003	.014	Trace	Slight trace.
947	Spring, Bridgton	August 27,	3.0	2.4	1.27	.2	.002	.014	Very slight trace.	Very slight trace.
948	Well, Augusta	September 7,	19.4	6.8	10.30	1.2	.008	.006	Heavy trace	Much.
949	Well, Hallowell	September 10,	5.4	2.8	3.90	.8	.002	.003	Very slight trace.	Heavy trace.
950	Spring, Topsham	September 10,	26.8	15.8	8.14	2.8	.001	.003	Heavy trace	Very much.
951	Well, Winslow	September 10,	19.4	5.8	17.22	.2	.006	.000	Very slight trace.	Very slight trace,

952	Well, Freeport	September 11,	35.4	10.8	11.05	1.4	.000	.008	Very slight trace.	Much.
953	Well, South Freeport	September 11,	10.8	2.6	7.43	5.4	.001	.006	Trace	Heavy trace.
954	Well, Dixfield	September 11,	3.8	3.0	5.20	.2	.000	.000	Very slight trace.	Trace.
955	Spring, Sanford	September 11,	9.0	7.8	3.90	.8	.000	.001	None	Much.
956	Spring, Cherryfield	September 13,	5.6	1.6	4.16	.4	.000	.000	None	Very slight trace.
957	Spring, Thorndike	September 23,	15.6	3.4	9.57	.8	.019	.006	Very slight trace.	Very slight trace.
958	Spring, Peru	September 19,	3.6	2.2	2.60	1.8	.003	.000	Very slight trace.	Much.
959	Well, Canton	September 25,	6.0	4.6	2.60	.0	.075	.015	Much.	Much.
960	Well, Winthrop	September 27,	12.0	4.2	5.43	.4	.003	.014	Very slight trace.	Heavy trace.
961	Well, Winthrop	September 27,	3.4	1.8	2.60	.2	.003	.003	Very slight trace.	Heavy trace.
962	Well, Portland	September 27,	8.6	2.8	3.90	1.2	.000	.005	None	Much.
963	Well, Portland	September 26,	14.2	2.6	8.14	2.4	.006	.002	None	Much.
964	Spring, East Newport	October 1,	8.4	4.6	6.00	.4	.002	.000	None	Much.
965	Well, Hollis	October 2,	13.6	4.2	4.57	1.6	.001	.008	None	Heavy trace.
966	Well, Livermore Falls	October 4,	19.6	12.2	7.43	1.4	.000	.002	None	Much.
967	Well, Brewer	October 4,	12.4	3.6	2.60	1.0	.008	.009	None	Very much.
968	Well, Bradford	October 11,	7.0	1.8	3.90	.2	.004	.006	Very slight trace.	Much.
969	Well, Pemaquid	October 12,	11.0	3.6	3.25	2.2	.003	.017	Very slight trace.	Heavy trace.
970	Well, Portland	October 15,	16.0	4.8	6.71	3.8	.004	.005	Very slight trace.	Heavy trace.
971	Spring, Gorham	October 15,	18.6	2.0	5.29	.2	.001	.000	None	Very slight trace.
972	Spring, Winslow	October 18,	18.4	3.6	6.71	.4	.001	.006	None	Much.
973	Spring, Winslow	October 19,	15.6	4.8	8.14	1.4	.001	.009	Very slight trace.	Much.
974	Well, Brewer	October 23,	34.8	14.6	12.56	3.4	.003	.006	Very slight trace.	Very much.
975	Well, Brownfield	October 24,	19.2	9.0	5.29	2.8	.001	.006	Very slight trace.	Much.
976	Well, Brownfield	October 24,	16.8	4.6	3.25	5.2	.000	.002	None	Much.
977	Spring, Brownfield.	October 24,	4.0	.8	1.27	.3	.000	.002	None	Heavy trace.
978	Spring, West Jonesport	October 24,	32.8	11.0	14.84	8.2	.003	.009	None	Much.
979	Well, South Monmouth	October 30,	25.6	9.4	11.80	2.8	.001	.007	Very slight trace.	Much.
980	Well, Peru	October 26,	3.4	2.6	1.69	.2	.000	.002	None	Very slight trace.
981	Spring, Limington	November 3,	2.2	.8	1.69	.3	.002	.002	None	Heavy trace.
982	Well, Phillips	November 6,	15.2	5.6	13.31	3.4	.000	.013	Very slight trace.	Much.
983	Well, Detroit	November 5,	34.2	11.2	18.81	5.2	.001	.005	Very slight trace.	Much.
984	Well, Detroit	November 5,	13.6	6.8	6.71	1.1	.013	.018	None	Much.
985	Well, Detroit	November 5,	13.6	6.4	5.29	1.1	.006	.030	None	Much.
986	Well, Detroit	November 5,	13.8	4.6	9.14	.8	.004	.008	None	Much.
987	Spring, Yarmouth	November 10,	11.6	6.8	5.00	1.6	.015	.006	Heavy trace	Heavy trace.
988	Cistern, Winterport	November 10,	5.2	1.2	3.25	.2	.001	.005	Very slight trace.	Slight trace.
989	Well, Winterport	November 11,	19.8	4.2	14.06	.6	.008	.012	Slight trace	Trace.
990	Water Supply, Norway	December 6,	4.0	3.2	2.34	.2	.003	.020	None	Very slight trace.
991	Spring, Standish	December 4,	4.2	2.2	2.21	.1	.001	.021	None	Very slight trace.
992	Pond, Standish	December 4,	3.4	3.0	1.69	.2	.037	.024	None	None.
993	Well, Augusta	December 6,	33.0	14.8	10.75	2.2	.003	.005	Trace	Much.
994	Well, Carmel	December 6,	20.2	6.8	9.29	3.8	.125	.012	Trace	Much.
		1895.								
995	——, Waterville	....	6.2	3.0	3.64	.3	.001	.028	Trace	Very slight trace.
996	Spring, Milbridge	....	5.6	1.6	3.25	1.0	.005	.002	Trace	Trace.

ANALYSES OF SAMPLES OF WATER—Expressed in Parts per 100,000—CONCLUDED.

Number of analysis.	Origin of sample.	Date of collection.	Total solids.	Loss on ignition.	Hardness.	Chlorine.	Free ammonia.	Organic ammonia.	Nitrites.	Nitrates.
997	Spring, Unity	February 15,	8.4	4.0	6.71	.3	.000	.003	None	Heavy trace.
998	Spring, Sanford	February 18,	5.0	2.4	2.60	.3	.001	.000	Trace	Slight trace.
999	Well, Lamoine	February 18,	11.4	6.4	3.25	2.0	.003	.002	Heavy trace	Heavy trace.
1000	Spring, Lamoine	February 18,	2.2	1.0	1.11	.5	.002	.006	Trace	llght trace.
1001	Well, Springvale	April 24,	21.0	13.2	7.43	2.8	.001	.002	Very slight trace	Much.
1002	Brook, Lisbon Falls	May 2,	5.8	4.2	2.34	.3	.002	.016	Very slight trace	Very slight trace.
1003	Stream, Lisbon	May 2,	4.8	4.4	1.85	.2	.001	.015	Very slight trace	Very slight trace.
1004	Well, Limington	May 9,	4.0	2.8	2.21	.2	.000	.001	Very slight trace	Trace.
1005	Well, Sabattus	May 10,	16.4	6.6	8.86	1.6	.000	.011	Trace	Much.
1006	Well, Bluehill	May 14,	45.4	16.6	17.22	8.8	.001	.009	Trace	Much.
1007	Well, Old Town	May 29,	34.4	8.2	13.31	5.8	.006	.020	Heavy trace	Very much.
1008	Spring, Houlton	May 30,	19.6	3.4	16.90	.4	.003	.005	Slight trace	Much.
1009	Well, Limington	May 30,	14.6	8.0	3.90	2.4	.003	.014	Very slight trace	Much.
1010	Water supply, Portland	June 5,	2.2	1.2	1.85	.2	.003	.010	Very slight trace	Slight trace.
1011	Well, Dixfield	June 5,	14.4	7.0	6.00	2.8	.001	.004	Very slight trace	Heavy trace.
1012	Reservoir, Augusta	June 8,	4.2	3.8	2.34	.1	.000	.014	None	Very slight trace.
1013	Reservoir, Augusta	June 8,	6.0	2.4	3.90	.7	.002	.004	Very slight trace	Very slight trace.
1014	Well, Rockland	May 27,	15.2	4.0	7.43	2.6	.001	.006	Very slight trace	Slight trace.
1015	Spring, Augusta	June 24,	19.6	7.8	12.56	.8	.000	.004	Slight trace	Much.
1016	Brook, Lisbon Falls	June 25,	7.8	3.8	3.90	.3	.002	.013	Trace	Very slight trace.
1017	Stream, Lisbon Falls	June 25,	5.4	2.8	3.25	.3	.001	.013	Slight trace	Very slight trace.
1018	Well, Lisbon Falls	June 25,	17.4	6.8	10.00	1.0	.001	.004	Slight trace	Heavy trace.
1019	Well, Lisbon Falls	June 25,	11.2	7.0	3.25	.8	.001	.013	Very slight trace	Very much.
1020	Well, Bowdoinham	June 16,	56.2	14.0	22.88	9.8	.022	.009	Trace	Much.
1021	River, South Berwick	July 2,	5.2	2.8	1.69	.3	.005	.021	Trace	Slight trace.

1022	Well, South Mt. Vernon	July 6,	9.2	4.6	4.67	.6	.004	.005	Trace	Slight trace.
1023	Well, East Baldwin	July 12,	4.4	2.4	2.34	.5	.003	.001	Very slight trace,	Heavy trace.
1024	Spring, West Minot	July 22,	4.6	2.6	1.95	.2	.000	.002	Very slight trace,	Heavy trace.
1025	Well, Litchfield	August 11,	14.2	6.2	9.14	.5	.000	.005	Trace	Trace.
1026	Well, Thomaston	August 20,	10.6	6.0	6.43	.7	.000	.012	Very slight trace,	Heavy trace
1027	Well, Old Orchard	August 22,	9.2	4.8	3.90	1.6	.298	.013	Trace	Trace.
1028	Stream, Lisbon Falls	August 21,	6.0	3.8	2.60	.4	.002	.023	Very slight trace	Heavy trace
1029	Brook, Lisbon Falls	August 21,	8.8	4.4	3.25	.4	.002	.017	Very slight trace.	Slight trace.
1030	Well, Garland	August 22,	9.0	2.4	6.71	.3	.003	.007	Trace	Heavy trace.
1031	Spring, Searsport	August 27,	5.4	2.4	2.60	.2	.000	.000	None	Trace.
1032	Well, Jefferson	August 29.	28.8	10.8	11.05	4.0	.003	.011	Trace	Very much.
1033	Well, Prout's Neck	September 5,	27.0	9.8	10.00	5.8	.010	.013	Trace	Much.
1034	Well, Presque Isle	September 7,	45.4	16.0	34.44	2.0	.003	.014	Much	Much.
1035	Spring, Presque Isle	September 9,	22.2	4.0	17.22	.2	.004	.003	None	Much.
1036	Spring, Presque Isle	September 9,	22.2	4.6	18.81	1.0	.000	.002	Very slight trace.	Much.
1037	Brook, Presque Isle	September 9.	16.8	3.8	13.31	.0	.003	.013	None	Heavy trace.
1038	Well, Bailey's Island	September 11,	14.4	3.4	6.43	2.6	.005	.008	Much	Heavy trace.
1039	Spring, Bangor	September 17,	15.8	5.4	10.60	1.6	.021	.011	Trace	Much.
1040	Well, Calais	September 17,	19.4	5.8	8.14	3.0	.092	.019	Much	Very much.
1041	Well, Saco	September 23,	9.2	3.8	3.64	1.4	.003	.012	Very slight trace.	Much.
1042	Spring, South Freeport	September 29,	2.8	2.2	1.69	.5	.001	.006	Very slight trace	Slight trace.
1043	Well, North Yarmouth	September 29,	12.4	6.6	4.29	1.0	.001	.003	Slight trace	Much.
1044	Lake, South Berwick	September 30.	2.8	2.0	2.21	.3	.002	.017	None	Very slight trace.
1045	Well, East Newport	September 30,	47.4	15.8	32.86	8.0	.004	.011	Much	Much.
1046	Well, Saco	October 2,	15.2	5.6	8.86	.9	.075	.041	Heavy trace	Heavy trace.
1047	——, Hallowell		10.2	8.4	5.29	.9	.003	.004	Trace	Heavy trace.
1048	Well, Farmington	October 1,	27.4	15.8	10.60	3.0	.001	.002	Trace	Very much.
1049	Spring, South Berwick	October 2,	6.8	2.8	2.99	.7	.003	.004	Very slight trace.	Heavy trace.
1050	Spring, South Berwick	October 2,	8.4	1.4	3.51	.7	.007	.006	None	Heavy trace.
1051	River, Saco	October 4,	7.2	2.2	1.56	.2	.000	.006	None	Slight trace.
1052	Pond, Waldoboro	October 12,	3.0	1.8	1.27	.4	.003	.015	None	Very slight trace
1053	Well, Eustis	October 22.	5.2	2.4	2.60	1.6	.000	.002	None	Very slight trace.
1054	Well, Biddeford	October 26,	12.2	5.2	6.00	1.6	.001	.005	Very slight trace.	Heavy trace.
1055	Water supply, Biddeford	October 26,	8.6	2.4	1.27	.2	.000	.009	None	Very slight trace.
1056	Well, Biddeford	October 26,	51.2	15.6	20.40	6.2	.001	.009	Very slight trace.	Much.
1057	Well, Biddeford	October 26,	23.0	4.8	13.31	2.0	.001	.004	Slight trace	Very much.
1058	Stream, Jefferson	October 28,	5.0	2.6	1.56	.3	.003	.015	None	Slight trace.
1059	Brook, Kennebunk	October 29,	2.8	2.6	1.27	.4	.009	.014	None	Very slight trace.
1060	Spring, Kennebunk	October 29,	3.4	2.0	.48	.4	.000	.004	Very slight trace.	Very slight trace.
1061	Well, East Dixfield	October 30,	6.4	2.4	6.00	.4	.003	.006	None	Trace.
1062	Well, Fryeburg	October 30,	2.6	1.2	1.69	.1	.000	.002	Very slight trace.	Trace.
1063	Well, Bangor	November 13,	38.4	7.6	23.60	2.8	.012	.012	Much	Very much.
1064	Well, Vassalboro	December 19,	35.6	12.0	19.60	6.4	.004	.015	Trace	Very much.

NOTES ON SOME OF THE SAMPLES OF WATER EXAMINED IN THE LABORATORY.

No. 930. A sample from a well sixteen feet deep and from sixty-five to ninety-five feet from apparent sources of pollution. The water was sent because it was thought possible that it had been the cause of sickness. The report on the sample said:

"The description of the location and surroundings of the well from which you sent a sample of water early in the year, is not unfavorable save the fact that there is a permeable stratum of sand at the top of the ground with an impermeable clayey subsoil. The moderate amount of organic matter in the water, I think we may well take as indicating that the process of oxidation of the polluting matter, as it passes down through the sand, is pretty complete. Nevertheless, the large excess of chlorine and of nitrates indicates a previous pollution from some source.

"In cases like this there is always an uncertainty. If the natural filter composed by the sandy soil could be assumed always to work as well as when the sample was taken, we could further assume the absence of danger in the future; but, as we have no sure grounds for such assumptions, I should deem it advisable for the family to obtain a source of drinking water elsewhere if they can. For all domestic purposes,—cooking, making tea and coffee, etc., this water may be used with safety."

No. 932. From a well fifteen feet deep, situated from thirty to fifty feet from the privy, stable, pig-pen, and cesspool for sink drainage. "The analysis of the sample of water sent by you gave unfavorable results,—results indicative of pollution. The distance of the privy and other possible sources of pollution is much too small. The make-up of the strata through which the well passes, loam above and ledge below, would greatly favor the pollution of the well."

No. 933. From a boiling spring remote from possible sources of pollution. "The analysis of the sample sent by you

gave results indicative of a water which is first-class for drinking purposes. There is hardly a better water in the State."

No. 937. A sample from a well thirteen feet deep, from which the water is brought through eight hundred feet of lead pipe. The sample was sent because the doctor feared lead poisoning. The water was found to contain a large quantity of lead. "The water is very soft and with such waters there is much more danger of their dissolving lead than there is of hard waters."

Nos. 941 and 942. These samples were from prospective sources of public water supply. The following report was made:

"On the back of this sheet you will find the figures obtained in the analysis of a sample of water from Bearce Pond and a sample from the Little Androscoggin River, received from you last month. I give you the figures, but hardly deem it best to advise you much as to their significance. It is preferable, I think, to leave that to your civil engineer to advise you after making himself acquainted with the character of the watershed of the various sources in question, aided by what light the chemical results may give. I will state that you may observe that the results obtained now in the examination of the sample from Bearce Pond are practically the same as those got about a year ago in the examination of a former sample from the same source, with the exception that last year a larger quantity of free ammonia, a very large excess, was found. The quantity of organic ammonia is also larger than it should be, greater than is found in any public water supply in the State. The excess of the ammonias in these samples I should guess arises from vegetable matter. In taking a sample from a pond for examination it should not, of course, be taken from the very edge of the pond where the water is shallow, but should be taken where there is considerable depth of water, at some distance from the shore, and not from the immediate surface. The character of the water is sometimes quite different at different points in a pond, for instance, one sample from a particular pond showed .059 parts of organic ammonia, another sample from a more favorable point farther from the outlet and from the influence of lily

pads and other vegetable matter and where the water was quite deep yielded only .015. I know nothing of the points from which your sample was taken, etc.

"If the supply from the pond may be deemed to be ample, I suppose the worst to be apprehended from the pond water would be bad tastes and bad smells sometimes in warm weather.

"On the other hand the absence of sewage contamination is the most important matter as regards the character of a drinking water supply."

No. 943. From a spring one-eighth of a mile from all sources of pollution. "The analysis of the sample of water sent by you indicates a pure, soft and good drinking water."

No. 944. From a shallow well thirty feet from the privy and twenty-eight feet from the stable. "The results of the analysis indicate a moderate degree of pollution. As to whether ill effects, that is, sickness, may result from using this water I cannot state positively. The analysis indicates a pollution from some source. Possible sources of pollution are much too near for safety. This water might be used for years with no ill results, and then possibly the infection of typhoid fever or some other disease might find its way to the well with the other matter which we know causes the pollution. For drinking water unboiled, I should deem it best for you to get water from some other source if you can. The water is safe after it is boiled and may therefore be used for general cooking and domestic purposes. It is rather a hard water."

No. 947. From a lake which was proposed as a source of public water supply. This lake has a length of three miles and an average width of about one mile. There are no houses upon the shore of the lake, with the exception of two near the outlet. The proposed intake is one-third of a mile above these houses. The following report was made:

"The accompanying blank will give you the figures obtained in the analysis of the sample of water sent by you. The results as indicated by the total solids and chlorine are very favorable. The amount of free ammonia and organic ammonia is slightly in excess of the average that we found in the examinations,

in 1888, of the samples from lakes and ponds. It is quite a soft water, somewhat softer than the average of river waters.

"The conclusions to be drawn from the results of this one analysis, so far as any conclusions can be drawn from a single analysis, are that the water is good and pure, but the results of a single analysis I should not deem worth nearly so much as an assurance of the permanent purity of the water as the description which you send of the lake and its surroundings. From your description the conditions appear to be very favorable."

No. 950. A sample of water from a spring from eighty to one hundred feet from sources of pollution of the usual character. This water was, however, brought nine hundred feet through lead pipe. "The quantity of organic matter in the sample of spring water which you sent is very moderate, but the results of the analysis indicate a slight degree of pollution which apparently comes some distance through the soil. There was, however, a large quantity of lead found in the sample, enough to make the use of the water undesirable and dangerous for drinking."

No. 952. From a drilled well seventeen feet in depth. The distance of the privy and sink drainage was only thirty feet. "The results of the analysis of the sample of water from the drilled well sent by you are favorable, nevertheless there is danger even in a drilled well in having possible sources of pollution so near. The treatment of the sink drainage and of the privy should be such as not to permit any filthy soakage into the ground in the vicinity of the well. I enclose circulars which will possibly offer useful suggestions."

No. 954. From a driven well sixteen feet in depth, sixteen feet from the privy, and twenty feet from the sink drain cesspool. "The results of the analysis of the sample of water sent by you are excellent; but though the results are not in the least unfavorable now, the privy and the sink drainage are much too near for permanent safety, even if it is a driven well. The privy and the sink drainage could be so managed that no filthy soakage may be permitted to pass down into the ground near the well."

No. 956. This water is of the kind which is usually furnished by the springs in this State when they are remote from the sources of pollution that are found about dwelling-houses and outbuildings. This spring is one hundred fifty rods from possible sources of pollution. The water is brought through galvanized iron pipes.

"The analysis of the sample of water sent by you shows that it is a water of great natural purity. In this sample there is a complete absence of organic matter. It is quite a soft water and well fitted for drinking purposes. You may, perhaps, have observed that when the water is boiled it becomes slightly milky, and possibly you have noticed that when the water stands for some time in a pail or other vessel a very slight scum forms on the surface. This is due to the presence of zinc dissolved by the water from the galvanized iron pipe through which it flows. Some good authorities claim that the amount of zinc soluble in water is not injurious. On the other side, some prefer not to have it in water. Very gradually the zinc will diminish and disappear in the water."

No. 965. From a well fifteen feet deep and from ten to sixty feet from sources of pollution of the usual character. "The analysis of the sample of water sent by you gives results that are, upon the whole, favorable. The distance, however, of possible sources of pollution is not so great as it should be. If the well water is to be used for domestic purposes I would advise some arrangement of privy vault or, still better, a well managed earth closet which shall not permit any drainage into the ground from this source. A tight iron drain for the sink drain is in the direction of a provision against danger, but unless the place where it discharges is much lower than the surface of the ground at the well, preferably as low or lower than the level of the bottom of the well, the sink drainage should be carried to a greater distance if practicable. The fact that the sink drain once discharged very near the well makes it certain that the soil about the well is polluted to a considerable depth, and increases the unfavorable impression which I have from the description of the surroundings of the well.

"The water from the well is, of course, freed from danger by boiling. It may, therefore, be used for all domestic purposes save drinking unboiled. If drinking water can be obtained from some other source, I should deem it preferable to get it for some time, at least."

No. 966. Sample from a well twelve feet deep, with possible sources of pollution from forty to seventy-five feet distant. There had been cases of typhoid fever. "The chemical results indicate nothing bad about it. It should be remembered, however, that the finding of a water to be chemically pure does not quite remove the possibility that it has caused typhoid fever. Infection may have been present two or three weeks before the sample was taken, when the mischief was done. It is also possible that a water be pure chemically and still be infected. The explanation of how this may be I cannot make here. Suffice it to say that if the water has been suspected, the greatest care should be observed in the future to prevent the possibility of soakage into the well from possible sources of pollution. The sample contains a trace of lead, and to avoid the danger of lead poisoning a quantity of water should be pumped out and thrown away before any is taken for use."

No. 967. This sample was from a well twenty feet deep and with sources of pollution from forty to sixty feet distant. "The analysis shows that the water is not good. Your description of the surroundings of the well indicate that the well is unfavorably located."

No. 988. "The sample of water from the cistern is much better than the average cistern water; in fact, I think it is the best water that has ever been received in the office derived from cisterns. Cistern water, however, varies much in character at different seasons of the year."

No. 994. From a well only seven feet deep, with the privy, stable, barn-yard and pig-pen within seventy-five feet of it. There had been cases of typhoid fever among the users of the water. "The water is badly polluted, so much so that the well must be considered a dangerous one. The water from a well which is badly polluted might be used for some time by a fam-

ily, or a community without producing alarming results, but the well is at any time in danger of receiving the germs of typhoid fever from the same sources from which it receives its elements of pollution. It would not, therefore, be surprising if recurring attacks of that disease should afflict the users of the water, particularly in the fall, if they should continue to use it."

No. 997. From a spring fifteen hundred feet from any possible sources of pollution. "The results indicate a spring water of great purity and well suited for drinking. It is a water of a medium degree of hardness."

No. 998. A spring nine hundred feet from sources of pollution. "The chemical results which are indicated numerically on the enclosed separate sheet show that the water is good and pure."

No. 999. This sample is from a well thirty-six feet deep and situated one hundred seventy-five feet from a cemetery. With the exception of about eight inches of loam at the surface, the well was dug through sand its whole depth.

"The analysis indicates a water not of the very best nor still positively bad. It is, therefore, impossible for me to make, from the results of the analysis, a positive statement whether the water is safe or whether it would sometimes prove to be unsafe. The location is unfavorable in that the distance from the burying ground is so slight and, again, in that the bottom of the well is about forty-four feet lower than the surface of the ground in the cemetery. That is certainly a pretty steep grade, nevertheless, in some investigations which have been made in Germany within a few years, samples of water from wells as badly and, as I remember, more unfavorably situated than that of yours were found to show no indications of pollution.

"Basing my judgment upon your description of the location of the well more than upon the results of the analysis, I am inclined to advise you not to use the water for drinking in an unboiled condition, if a water supply can be obtained from other sources."

No. 1,004. This was a well water which was suspected of having caused lead poisoning. "Otherwise than a slight trace

of lead found in the water it is very pure and suitable for drinking. As I understand from the blank which you send, the water is constantly running through the lead pipe. Under those circumstances there would not be so much danger of lead in the water as there would if the water stood a part of the time in the lead pipe. But this is quite a soft water and waters of that character are more likely to dissolve lead than harder waters. Waters also at different times, and sometimes from unknown causes (the same waters, I mean) dissolve lead more readily than at other times. It may, therefore, be that at times this water has contained a larger quantity of lead than there was in the sample which you sent."

No. 1,007. From a shallow well, with the privy sixty feet, and sink drainage only forty feet distant. The land sloped toward the well. "The sample of water which you sent May 29, is badly polluted and is unfit to be used for drinking. The figures obtained in the analysis are shown on the enclosed sheet."

No. 1,009. From a well where the privy is seventy-five feet distant, and with other sources of pollution no farther away. "The sample of water sent by you is found upon analysis to be polluted in a moderate degree, and I should judge that the source of the pollution is the privy vault. Wells situated as this one is with relation to the privy, on slightly lower ground, and drilled, or blasted into ledge are much more liable to pollution than if no rock intervened.

"I cannot say that the illness complained of by some of the members of the family is due to the pollution of the water, but, of course, it is undesirable to use such water, and in using it one incurs the risk of drinking typhoid fever or other germs of disease some time."

No. 1,011. This sample was from a well twenty-three feet deep, with the privy only thirty feet away and other sources of pollution from sixty to seventy-five feet distant. "The results show that there is a slight degree of pollution of the water, although the polluting matter in filtering through the soil is quite completely changed and removed. I cannot answer the

question whether this water was the cause of typhoid fever in your daughter. Why I cannot, you will understand better after reading what is said on page 24, of the Eighth Report, a copy of which I send you.

"The water from this well is certainly perfectly safe to use after it is boiled, but since you have had one case of typhoid fever on the premises, and the privy is nearer to the well than it should be, I should deem it best not to use unboiled water from this well for drinking purposes."

No. 1,020. From a bored well fifty-two feet deep. The privy, stable, barn-yard and sink drainage were less than fifty feet distant. "The results of the analysis show that the water is not good; it is polluted quite seriously."

No. 1,024. From a spring with no sources of pollution nearer than one-eighth of a mile distant. "The figures obtained in the analysis of a sample of the spring water are shown on the back of this sheet. They indicate a very soft and pure water, suitable in every way as a drinking supply."

No. 1,027. A sample of water from a well only ten feet deep and unfavorably situated. Three sink drains were within thirty-five and forty feet of the well. "The results are unfavorable; they indicate pollution, and still more strongly your description of the surroundings of the well shows that water from it is unfit and unsafe to be used for drinking."

No. 1,031. From a spring nearly one-fourth of a mile from houses or other sources of pollution. "The results are very excellent indeed. It is a very pure and good water for drinking. It is quite soft for a spring water."

No. 1,033. This sample was taken from a driven well thirty-five feet in depth. "Though in most driven wells there is not quite so much danger from surface pollution as with wells which have been dug, the results obtained in the analysis of this sample indicate quite clearly a degree of pollution which is rather more than moderate, and which, in my opinion, renders the well undesirable as a source of drinking water."

No. 1,040. From a well eighteen feet deep, with sources of pollution from ten to one hundred feet away. "The results in-

dicate that the water is badly polluted. Such a water is unfit to use as a drinking supply."

No. 1,041. From a well twelve feet deep, with sources of pollution too near. "The analysis indicates a moderate degree of pollution,—but a degree great enough so that I should think that there is some risk in using the water unboiled. For making tea and coffee, and other domestic purposes, it is perfectly safe after it has been boiled, but for the somewhat limited drinking supply which you will need unboiled, it would be well to obtain it from some other source. A well which is dug down to, or into a ledge, when the ledge is not very far from the surface, is more likely to be polluted than some other sorts of wells. All possible sources of pollution are much too near, though as regards some of them, the sink water particularly, you manage quite carefully."

No. 1,045. From a well fifty-seven feet deep. This well was dug a few feet through the soil and then into a porous ledge, and then blasted forty feet or more. Sources of pollution were well within the area of the drainage of the well.

"The analysis shows that it is polluted in a considerable degree, enough so that I should not wish to use the water for drinking purposes if I were in your place, excepting after it has been boiled. It is, of course, entirely safe to use it for making tea and coffee and for all domestic purposes after it is boiled. If the comparatively small quantity needed for drinking water could be obtained from some less risky source, it would certainly be better to do so. This is a very hard water, harder than is often found outside of Aroostook and a few other limestone regions in the State. Wells dug and blasted into a rock or ledge are much more liable to pollution than wells that are sunk through the soil or earth all the way. Most ledges have seams which often carry the drainage from the soil above along its surface directly into the well."

No. 1,047. From a well sixteen feet deep and unfavorably located on account of the proximity of sources of pollution. "The results of the analysis indicate a degree of pollution which, though moderate, is decided enough to make the water an un-

desirable one for drinking purposes. Particularly when the water has a bad taste and smell it should not be used, and at all times on account of the nearness of the privy, sink drain, stable, pig-pen, etc.,the water should be considered a dangerous one; not that the drinking of it will invariably produce sickness, but those persons who drink it are liable at any time to attacks of typhoid fever or other disease,—much more likely to be affected with them than persons who drink pure water. The test indicates a trace of lead which renders the water still more undesirable."

No. 1,052. From Little Medomak Pond, which is under consideration as a source of public water supply. "On the back of this sheet I make a tabular statement of the figures obtained in the analysis of the sample of water sent by you, together with those obtained in the examination of some of the public water supplies in the year 1888. The comparison may be of interest to you.

"I report results, but cannot give a judgment whether this sample is from a source which will be a suitable one for a public water supply. So far as the chemical results with this one sample are concerned, there is nothing wrong, with the exception that the free ammonia, (usually taken as one of the indications of organic matter) is in excess of the average quantity found in any public water supply in the State, so far as I have examined them. Examined at other seasons, the results might be better; they might be worse.

"One reason why I cannot pronounce on the suitability of this proposed source is because, to do so, I must know what the character of the water is at other seasons of the year. This Board has, therefore, insisted upon the need of a series of analyses carried preferably through a whole year, a sample being taken every month or two.

"Another reason is because this Board in all cases, strongly advises not to depend wholly upon chemical analyses to settle the question. Chemical examinations are of value, but a careful inspection of the proposed source and all its watershed by a person experienced in such work, for the purpose of determin-

ing the possibilities and probabilities of pollution of the water, present and future, is of more importance than the chemical work.

Turning now to the tabular arrangement on the back of the first sheet, you will find a statement of the average results of the examination of several samples of water from six public water supplies. In Augusta the water is taken from the Kennebec River; in Bangor, from the Penobscot; in Bar Harbor, from Eagle Lake, a sheet of water about two miles in length and a mile in breadth; in Belfast, from an artificial pond on Cole's Brook; in Biddeford, from the Saco River; in Fryeburg, from White Lot Brooks, Conway, N. H. Of the six samples from the Augusta supply, one in February had two parts of free ammonia, and one in May had three parts per thousand, the other samples had none. Of the five samples from Belfast, one in October had three parts per thousand, the same as your sample. Among the samples from Fryeburg, one in October had five parts of free ammonia, and none in any of the other samples. You will note both Belfast and Fryeburg are supplied from artificial ponds on small streams, and that the excess of free ammonia occurred in October, presumably from the abundance of recently fallen leaves macerating in the water. This may be the reason for the excess of free ammonia in the sample that you have sent. Again, it may be due to indiscretion in taking the sample. It may have been taken too near the shore where the water is too shoal. Your intake, if your supply is taken from this pond, would, of course, be at some distance from the shore, and preferably where the water is of considerable depth. In collecting the sample, if you did not do so, you should have taken it from such a place as the intake will be laid.

"The hardness of the water is principally an economic question. The sample which you sent is quite a soft water, slightly softer than the average river water in the State."

Nos. 1,059 and 1,060. "Prefacing my report on the samples of water which you sent, I would say that what may be learned from the careful ocular inspection of a stream and of its watershed, will give data which are worth more than chemical analy-

ses in determining whether the water will be suitable as a public water supply. If, however, the chemical results should be decidedly unfavorable, particularly when a series of analyses show unfavorable results, it would be unwise to choose such a source. When the chemical results are favorable, the information which may be derived from an acquaintance with the course of the stream ,and particularly from a careful inspection of it, is needed to show whether there are any sources from which polluting matter may reach the stream in the future.

"The figures which were obtained in the analyses of the two samples of water will be found on the back of this sheet.

"Analysis No. 1,059, sent in bottle No. 95, from Branch Brook. This sample contains an excess of free ammonia, much more than is found in any other public water supply in the State, so far as they have been examined. The rather large quantity of organic matter which this excess of free ammonia indicates may have been derived in part from fallen leaves. A series of examinations at various seasons of the year would determine whether this excess is constant or only seasonal. Possibly it was derived, in some measure, from the sources mentioned on the blank which you returned.

"The analysis No. 1,060, in bottle No. 108, from a spring feeding Branch Brook. This is a very pure water and one of excellent quality for drinking purposes. It is, furthermore, a remarkably soft water."

ADDITIONS TO THE LIBRARY.

During the years 1894 and 1895 the following books, journals, and pamphlets were added to the library of the Board by exchange and purchase.

Books.

Atwater. Methods and Results of Investigations on the Chemistry and Economy of Food. Washington. 1895.

Corfield. Dwelling-Houses. London. 1894.

Gerhard. Sanitary House Inspection. New York. 1895.

Heron. Evidences of the Communicability of Consumption. London. 1890.

Kenwood. Public Health Laboratory Work. Philadelphia. 1893.

Newsholme. The Elements of Vital Statistics. London. 1892.

Poore. Rural Hygiene. London. 1894.

Reeves. Medical Microscopy. Philadelphia. 1894.

Rideal. Disinfection and Disinfectants. London. 1895.

Stokes. Microscopical Praxis. Trenton, N. J. 1895.

Fresh Water Algae and the Desmidieae of the United States. 1893.

Taylor. The Sanitary Inspector's Handbook. London. 1893.

Vacher. Food Inspector's Handbook. London. 1894.

Infectiousness of Milk. Boston. 1895.

The Care of Dependent, Neglected and Wayward Children. Chicago. 1893.

Behring. Die Geschichte der Diphtherie. Leipzig. 1893.

Die Blutserumtherapie. Vols. I. II. Leipzig. 1892.

Bernheim. Immunization et Serumtherapie. Paris. 1895.

Burgerstein und Netolitzky. Handbuch der Schulhygiene. Jena. 1895.

Duchenne. Physiologie der Bewegungen. (Trans. by Dr. C. Werwicke.) Berlin. 1885.

Knopf. Les Sanatoria Traitement et Prophylaxie de la Phthisie Pulmonaire. Paris. 1895.

Leffmann and Beam. Analysis of Milk and Milk Products. Philadelphia. 1893.

Liebe. Ueber Volksheilstatten für Lungenkranke. Breslau. 1895.

Magelssen. Ueber die Abhangigkeit der Krankheiten. Leipzig. 1890.

Mosso. Korperliche Erziehung der Jugend. Hamburg and Leipzig. 1894.

Neefe. Statistisches Jahrbuch Deutscher Stadte. Breslau. 1893.

Neumann. Offentlicher Kinderschutz. Jena. 1895.

Plange. Die Infections-krankheiten. Berlin. 1894.

Van Bebber. Hygienische Meteorologie. Stuttgart. 1895.

Weyl. Die Einwirkung Hygienischer Werke auf die Gesundheit der Städte. Berlin. 1893.

Die Haupstadt Budapest im Jahre 1891. Resultate der Volksbeschreibung und Volkszahlung. Berlin. 1894.

Year Book of the Department of Agriculture. Washington. 1894.

Transactions of the Sanitary Institute of Great Britain. XII. 1891.

Transactions of the New York Academy of Medicine. 1893.

Reports and Papers of the American Public Health Association. XVIII. 1892.

Eleventh Census United States. 1890. Part II. Part III.

Report on Population of the United States at the Eleventh Census. 1890.

Statistisches Jahrbuch der Stadt Berlin. 1892. 1895.

Statistik der Infectiosen Erkrankungen in den Jahren 1881—1891 und Untersuchung des Einflusses der Witterung. Berlin. 1894.

Reports.

Alabama. Report of the State Board of Health. 1894.

California. Thirteenth Biennial Report of the State Board of Health. 1893-94.

Colorado. Fourth Report of the State Board of Health. 1892-93-94.

Connecticut. Seventeenth Annual Report of the State Board of Health. 1894.

Delaware. Eighth Biennial Report of the State Board of Health. 1892-94.

Florida. Sixth Annual Report of the State Board of Health. 1894.

Kansas. Tenth Annual Report of the State Board of Health. 1894.

Massachusetts. Twenty-Sixth Annual Report of the State Board of Health. 1894.

Michigan. Twentieth Annual Report of the State Board of Health. 1892.

Minnesota. Fifteenth Report of the State Board of Health. 1893.

New Jersey. Eighteenth Report of the State Board of Health. 1894.

North Carolina. Fifth Biennial Report of the State Board of Health. 1893-94.

Ohio. Ninth Annual Report of the State Board of Health. 1894.

Ontario. Thirteenth Annual Report of the Provincial Board of Health. 1894.

Pennsylvania. Ninth Annual Report of the State Board of Health. 1893.

Rhode Island. Sixteenth Annual Report of the State Board of Health. 1893.

South Dakota. Biennial Report of the State Board of Health 1893-94.

Boston, Mass. Twenty-third Annual Report of the Health Department. 1894.

Chicago. Annual Report of the Department of Health. 1894.

Montreal. Report on the Sanitary State of the City. 1893-94.

New York. Annual Report of the Health Officer. 1893.

Portland, Maine. Annual Report of the Board of Health. 1894-95.

Providence, R. I. Twelfth Annual Report of the Superintendent of Health. 1894.

Raleigh, N. C. Reports of Health Department for years ending Feb. 28, 1894-95.

St. Louis, Mo. Seventeenth Annual Report of the Health Commissioners. 1894.

Michigan. Twenty-sixth and Twenty-seventh Registration Reports. 1892-93.

Minnesota. Fourth Biennial Report on Vital Statistics. 1892-93.

Ontario. Report on Births, Marriages and Deaths. 1893.

Rhode Island. Forty-first Registration Report. 1893.

Vermont. Thirty-eighth Report on Births, Marriages, Deaths, and Divorces. 1894.

England. Fifty-fifth and Fifty-sixth Annual Reports of the Registrar-General of Births, Deaths and Marriages. 1892-93.

Providence, R. I. Fortieth Annual Report of Births, Marriages and Deaths. 1894.

Providence, R. I. Annual Report of City Engineer. 1892-93-94.

Annual Reports of the Supervising Surgeon-General, M. H. S. Washington. 1893-94.

Report as to the Sanitary Condition of Tenements of Trinity Church, N. Y. 1895.

Seventh Annual Report of the Experiment Station. State Agricultural College. 1894.

Second Annual Report of Factory Inspectors of Illinois. 1894.

Report of the Ninth Annual Meeting of American Association for the Advancement of Physical Education. New Haven, Conn. Apr. 5, 6, 7, 1894.

Bruxelles Rapport presente Au Conseil Communal en seance du 1 er Octobre. 1894.

PAMPHLETS.

Abbott. Isolation Hospitals for Infectious Diseases. Radical difference in Methods of Production and Cultivation of Vaccine Lymph. 1894.

Hintrager. Die Volksschul-Bauten in Norwegen. Wien. 1895.

Homan. A Contribution to the Study of Water-Borne Cholera. 1895.

Law. Tuberculosis in relation to Animal Industry and Public Health. Cornell University Experiment Station. April. 1894.

Lee. Ten Years of a State Board of Health.

Mills. The Filter of the Water Supply of the City of Lawrence. 1893.

Watson. Special Report on Bovine Tuberculosis. Norristown.

The Vital Statistics of Massachusetts for 1893.

Official Register of Physicians. 1891-95. Minnesota.

Journal of the Elisha Mitchell Scientific Society. 1894. Chapel Hill, N. C.

Proceedings and Addresses at a Sanitary Convention held at Union City, Mich., Oct. 25-26, 1894.

Proceedings and Addresses at a Sanitary Convention held at Charlotte, Mich., Nov. 22-23, 1894.

Proceedings of the Twelfth Annual Convention of the National Confectioners' Association of the United States. 1894-95.

Proceedings of the Third Annual State Sanitary Convention. San Francisco, Cal. 1895.

Proceedings and Addresses of the Second Annual Conference of Health Officers in Michigan. Ann Arbor, June 14-15, 1894.

Abstract of Proceedings of Michigan State Board of Health. Regular Meeting, Jan. 11, 1895.

Transactions of the Maine Medical Association. 1895. Vol. XII.

Statistical Report of Bureau of Health, Denver, Col. 1892-93-94.

Sanitary and Other Journals.

The Sanitarian. Brooklyn, N. Y. 1894-5.
The Annals of Hygiene. Philadelphia. 1894-5.
The Engineering Record. New York. 1894-5.
The Sanitary Record. London. 1894-5.
The Boston Medical and Surgical Journal. Boston. 1894-5.
Architecture and Building. New York and Chicago. 1894-5.
Brooklyn Medical Journal. Brooklyn, N. Y. 1894-5.
Medical News. Philadelphia. 1894-5.
Medical Times. New York. 1894-5.
Medical Standard. Chicago. 1894-5.
Medical Review. Pittsburgh. 1894-5.
The Microscope. Washington. 1894-5.
The American Monthly Microscopical Journal. Washington. 1894-5.
Modern Medicine and the Bacteriological Review. Battle Creek, Mich. 1894-5.
Occidental Medical Times. Sacramento. 1894-5.
American Analyst. New York. 1894-5.
The National Popular Review. Chicago. 1894-5.
The Universal Medical Journal. Philadelphia. 1894-5.
The Doctor of Hygiene. New York. 1894-5.
Texas Sanitarian. Austin. 1894-5.
Journal of Practical Medicine. New York. 1895.
The Medical World. Philadelphia. 1895.
The Municipality and County. Buffalo, N. Y. 1894-5.
The National Board of Health Magazine. New York. 1895.
Journal of Medicine and Science. Portland, Me. 1895.
Lehigh Valley Medical Magazine. Easton, Pa. 1895.
Columbus Medical Journal. Columbus, Ohio. 1894-5.
Journal of New England Water Works Association. New London, Conn. 1894.
The Philadelphia Polyclinic. Philadelphia. 1894-5.
Bulletin of the New England Weather Service. Boston, Mass. 1894-5.
Public Health in Minnesota. Red Wing. 1894-5.

Monthly Bulletin of the Iowa State Board of Health. Des Moines. 1894-5.
Bulletin of the State Board of Health of Tennessee. Nashville. 1894-5.
Bulletin of the North Carolina Board of Health. 1894-5.
Monthly Bulletin of the State Board of Health of Rhode Island. 1894-5.
Monthly Sanitary Record, State Board of Health of Ohio. 1894-5.
Florida Health Notes. 1894-5.
Abstract of Sanitary Reports. Washington. 1894-5.
Public Health. London. 1894-5.
The Lancet. London. 1894-5.
Index Medicus. Detroit and Boston. 1894-5.
Revue D'Hygiene. Paris. 1894-5.
Annales de L' Institut Pasteur. Paris. 1895.
Archiv für Hygiene. Munich and Leipzig. 1894-5.
Zeitschrift für Hygiene. Berlin. 1894-5.
Deutsche Vierteljahrsschrift für Offentliche Gesundheitspflege. Braunschweig. 1894-5.
Deutsche Medicinische Wochenschrift. Berlin. 1894-5.
Zeitschrift für Schulgesundheitspflege. Hamburg. 1894-5.
Arbeiten aus dem kaiserlichen Gesundheitsamte. Berlin. 1894-5.
Centralblätt für Bakteriologie und Parasitenkunde. Jena. 1894-5.
Gesundheits-Ingenieur. München. 1894-5.
Gesundheit. Frankfurt a. M. 1895.
Veroffentlichungen des kaiserlichen Gesundheitsamtes. Berlin. 1894.
Hygienische Rundschau. Berlin. 1894.
Schweizerische Blätter für Gesundheitspflege. Zurich. 1894-95.
Giornale della Reale Societa Italiana D' Igiene. Milano. 1894-5.
La Salute Pubblica. Perugia. 1894-5.
Boletin del Consejo Superior de Salubridad. Mexico. 1895.

ABSTRACTS FROM THE REPORTS OF THE LOCAL BOARDS OF HEALTH.

ABBOT.

1894. The bog near the cemetery was deemed a nuisance and we had it drained. Two other nuisances were found which were abated. No cases of infectious disease occurred.

1895. Three nuisances were abated. We had one case of typhoid fever in a mild form. One schoolhouse was in an unhealthy condition: the building was closed and the causes were removed.—George A. Davis, Sec.

ACTON.

1894. One case of diphtheria occurred. 1895. This year we have had no cases of contagious diseases, with the exception of whooping cough in the latter part of the year, which caused a suspension of the school for a short time.—B. J. Grant, Sec.

ADDISON.

1894. We had three cases of typhoid fever, one of which was fatal.

1895. None of the specified contagious diseases has occurred.—U. W. Curtis, Sec.

ALBANY.

1894. There have been no cases of contagious diseases save one of typhoid fever, and German measles in February. The sanitary condition of the town is good.

1895. There have been no contagious diseases. The general health of the people has been very good.—George W. Beckler, Sec.

ALBION.

1895. We had three cases of diphtheria and the same number of scarlet fever.—Dr. F. E. Withee, Sec.

ALEXANDER.

1894. There has been but little sickness in our town. There were three cases of scarlet fever.

1895. No cases of infectious diseases have been reported to the board.—A. H. Perkins, Sec.

ALFRED.

1895. Cases of infectious diseases are reported when they occur, but we have had none this year.—Dr. C. E. Lander, Sec.

ALNA.

1894-95. This board has had no nuisances nor cases of disease reported to it.—A. B. Erskine, Sec.

ALTON.

1895. I have no cases of infectious diseases to report, with the exception of one case of typhoid fever. Two horses brought from the West soon were taken with fever, and one died.—H. L. McKechnie, Sec.

AMHERST.

1895. With the exception of whooping cough, there have been no contagious diseases. S. S. Goodwin, Sec.

AMITY.

1895. We had some cases of whooping cough, but otherwise no contagious diseases. Considerable sickness was caused in the summer by the low water and bad water, so the local doctor said.—George E. Nickerson, Sec.

ANDOVER.

1894-95. No cases of diphtheria, scarlet fever or typhoid fever were reported to us during the two years.—George O. Huse, Sec.

ANSON.

1894. Six cases of scarlet fever and two of typhoid fever. Quarantine and proper medical care are taken of such cases. We have remarkably few cases of contagious diseases.

1895. One case of diphtheria and nine of typhoid fever. The circulars were distributed, the houses placarded, and all necessary precautions taken. Seven of the cases of typhoid fever were in one house, and it is thought that they were caused by polluted well water.—George F. Newell, Sec.

APPLETON.

1894. No cases of infectious diseases have occurred.—Levi W. Butler, Sec.

1895. No cases of infectious diseases, with the exception of measles in September. The drainage in the village has been much improved, and two systems of water supply have been put in which supply several families.—Dr. S. P. Strickland, H. O.

ARGYLE.

1894. No nuisances and no infectious diseases.

1895. One nuisance was removed. We had two cases of typhoid fever.—J. M. Freeze, Sec.

ARROWSIC.

1895. We have had no cases of contagious diseases.—C. C. Shea, Sec.

ASHLAND.

1895. Eight cases of scarlet fever and one of typhoid fever. Whooping cough occurred in the spring.—Dr. H. L. Dobson, H. O.

ATHENS.

1895. No cases of infectious diseases, with the exception of mumps. There was one case of poisoning from arsenical paint.—F. V. Barker, Sec.

AUBURN.

1894. A meeting of the board is held every Friday morning. Considerable improvement has been made in our water supply, and the sewerage system has been extended and improved. Twenty-two nuisances reported to the board were all removed. We had twelve cases of diphtheria, sixteen of scarlet fever and ten of typhoid fever. Infected buildings have been placarded

and disinfection has been carried out in connection with these cases.

1895. Our water supply is taken from Lake Auburn, and the system of distributing it has been enlarged. Carts collect garbage and excreta every Saturday morning, or oftener when needed. Thirty-four nuisances were abated. Eighteen cases of diphtheria, thirty-three of scarlet fever and seventeen of typhoid occurred. There was some prevalence of whooping cough. One woman was fatally burned by the explosion of some kind of stove blacking.—Dr. A. M. Peables, H. O.

AURORA.

1894. One case of typhoid fever.—A. E. Mace, Sec.

1895. We had no infectious diseases, with the exception of one case of typhoid fever.—H. T. Silsby, Sec.

AVON.

1894. There has not been a case of contagious disease in town, to my knowledge.—G. T. Jacobs, Sec.

BAILEYVILLE.

1894. We had two cases of typhoid fever.

1895. Scarlet fever entered one family.—Dr. J. D. Lawler, H. O.

BALDWIN.

1894. Nine cases of scarlet fever and one of typhoid fever. Isolation and disinfection were carried out.

1895. One case of diphtheria and two of typhoid fever. One of the cases of typhoid is supposed to have been taken from the water on the cars in coming from California.—Dr. Lorenzo Norton, Sec.

BANCROFT.

1895. We had two cases of scarlet fever.—Wm. Quimby, Sec.

BANGOR.

1894. About 5,000 feet of new sewers have been constructed. One hundred and twenty-five nuisances were re-

ported, all of which were removed or discontinued. One case of small-pox, twenty-two of diphtheria, nine of scarlet fever and sixty of typhoid fever occurred. When reports of contagious diseases are received, the secretary immediately notifies the school agent, giving him the street and number of the house and the school at which the children attend; he attends personally to the placarding of the infected house, and leaves with the family appropriate circulars issued by the State Board. If the case is of peculiar malignancy the secretary visits the house daily, and observes the required precautions at the termination of the disease. Public libraries are also notified of infectious cases.

1895. This year 5,840 feet of new sewers were laid. One hundred and forty nuisances were reported to the board, and all were attended to. This year there were seven cases of diphtheria, twenty-seven of scarlet fever and fifty-five of typhoid fever. All the cases of diphtheria and scarlet fever are reported promptly and are looked after very closely.—John Goldthwaite, Sec.

Baring.

One nuisance, reported to the Board in 1894, was removed, but no cases of infectious disease occurred in either year.—Joseph Stevens, Sec.

Beddington.

1894. When cases of infectious diseases occur they are reported to the Board, but none have occurred this year, with the exception of five cases of whooping cough in January.

About 150 or 200 yards below the graveyard in this town, and on a down grade from it, there stands a house in which there has been considerable sickness. One time the inmates thought the water tasted of something, but they knew not what. I was there and spoke of the burying-ground, and I would like to have your opinion as to whether the water will free itself in going that distance.—C. B. Farnsworth, Sec.

(Answer, January 12, 1896. "I cannot answer your question with any degree of positiveness, for different kinds of soil or ground have different degrees of capability of purifying polluted

matter in the water or soakage which passes through them. If the ground is of a somewhat uniform character some distance down; that is, if it is sand or ordinary soil with a hardpan not too solid, I should suppose there would be no danger to the house or to a well situated the distance below it mentioned in your note. But if a little way below the surface there is a ledge or an impermeable hardpan of clay, I should think it quite likely that a well below, at the distance mentioned by you, and in the direct line of drainage, might be polluted.

If you wish me to do so, I will make an examination of a sample of water from the well at such time as we have time to do so, probably not before spring. The analysis might show pollution of the water and, on the other hand, it might not be present in the sample sent, and still not excluding the possibility of the burying-ground's affecting the well at times. But may there not be other possible sources of pollution much nearer to the well?"—A. G. Y.)

1895. We had two cases of scarlet fever, and whooping cough was prevalent.—A. F. Libbey, Sec.

Belfast.

1895. Some extension has been made of the water supply system, and $2,000 have been expended in the construction of sewers. Sixty-eight nuisances were reported to the Board, all of which were abated with the exception of five. We had five cases of diphtheria, five of scarlet fever and one of typhoid fever. The treatment of the first case of diphtheria shows what may be done in outbreaks of this kind. This outbreak was stopped and, apparently, a long run of the disease was prevented, but to do it required work, day and night.—Dr. L. W. Hammons, Sec.

Belmont.

1894. We have had no cases of contagious diseases in town this year. 1895. No contagious diseases, whatever, this year. —O. C. Cammett, Sec.

Benedicta.

There have been no contagious diseases of any kind in either year. It has been very healthy.—T. F. Ryan, Sec.

Benton.

1894. One nuisance was abated. Five cases of typhoid fever.

1895. Two cases of diphtheria, three of scarlet fever and one of typhoid fever. Diphtheria and scarlet fever cases are placarded as the law requires.—A. L. Plummer, Sec.

Berwick.

1894. Twenty-one nuisances were abated. One case of diphtheria, one of scarlet fever and two of typhoid fever. Houses have been placarded, sick isolated, and general disinfection followed recovery or death. We have vaccinated about 250 of our inhabitants, nearly all of which took successfully. We have had an unusually healthy year.—Dr. P. B. Young, Sec.

1895. Six nuisances were reported to the Board, all of which were removed. Nine cases of scarlet fever and four of typhoid fever. Quarantine and the distributing of pamphlets were carried out. Whooping cough was present in December, and mumps troubled the schools.—Dr. C. A. Ferguson, Sec.

Bethel.

1894. Some improvements were made in sewerage. The water supply has been perfect for five years or more. We had one case of typhoid fever. The fact that Bethel seldom has epidemic diseases of late seems to prove to our minds the necessity of pure water as a great helper in the prevention of sickness. This condition of things has been noticeable in our village since we have been supplied with pure brook water taken from the mountain side four miles away.

1895. One nuisance was abated. We have had no cases of specified contagious diseases.

Three years ago, a young lady living in ———, Me., was troubled with a bronchial affection for years, which constantly increased, until a physician ordered her to go to Bethel, as he considered it a healthy locality among the mountains, and especially favorable to the relief of trouble such as hers. After staying here a few months, she was so much better that she returned

to her home. But the old trouble immediately came on and she was unable to lie down at night. She returned to Bethel and on the first night had a good night's sleep. The old trouble left her in a few weeks, and at the end of three months she returned again to her old home. But it was of no use; she could not live there and, last April, she returned to Bethel and is still boarding here. Since her return there has not been the slightest attack of bronchial trouble during the eleven months. It is very seldom indeed that the natives of Bethel have trouble of this kind.—A. W. Grover, Sec.

BIDDEFORD.

1894. Several nuisances were reported to the board and several were removed. Six cases of diphtheria, thirty-five of scarlet fever and eleven of typhoid fever. A large proportion of the cases of scarlet fever was among children attending school. Better sewers are needed, and places to be used in the burning of garbage.

The experience of our board suggests that it would be an improvement in the health laws if the local boards were empowered, after serving notice, that all vaults not attended to, should be cleansed by order of the board of health, and charged to the owner and collected in the same way as are the taxes, or, in other words, copy the laws of Massachusetts.—Daniel Coté, Sec.

1895. The water company has put in a Warren filter, and sewers have been extended, 4,600 feet. A pond which had become a nuisance, together with a tract of low land which from its surroundings would soon have become a nuisance, have been drained. Forty-three nuisances have been reported and nearly all have been abated. We have a few places where cesspools have become a nuisance, and they cannot be remedied until sewers are extended to receive the drainage.

Diphtheria, fourteen cases; scarlet fever, thirty-two; typhoid fever, eighty-nine. Patients have been isolated, circulars distributed, disinfection used after recovery, sulphur fumigation and cleansing in connection with diphtheria and scarlet fever,

and infected houses were promptly placarded. Public funerals are not allowed when death has occurred from contagious diseases. Five of the cases of typhoid fever were contracted in other states and the persons have returned to their homes sick. Quite a number of the cases of typhoid fever were supposed to have been caused by drinking water from a canal which receives filthy drainage. Sixteen of the cases of typhoid fever, in nine different houses, all used milk supplied by one man in whose house there were several cases of typhoid fever. We believe that to have been the agency through which the disease was spread.

In one of the schoolhouses the plumbing was defective and we had it overhauled and improved. In another school the privy vaults were removed and replaced with improved water closets. When contagious diseases enter the schools, we notify the superintendent or teachers of the nature of the disease, and the infected pupil is not allowed to re-enter the school until the case is considered free from the danger of infection. We have had but one school closed and that but a short time. There has been no spread of contagious diseases in our schools.—Wm. F. Libby, Sec.

By-laws of the Board of Health of the city of Biddeford.

Section 1. It shall be the duty of the secretary of the board of health of the city of Biddeford to keep a record of all matters pertaining to the action of the board.

Section 2. On complaint, or information by any person, that a nuisance, or any cause of danger to public health exists on any premises, or in any part of the city, some member of the board shall immediately examine the same, and the board shall take such action in the case as may be necessary.

Section 3. Any persons engaged in cleaning out privy vaults within the jurisdiction of this board shall be required to use carts for that purpose that are water tight, and such carts shall not be permitted to stand on any public street or lane, except while being loaded, and only to be used between the hours of ten, P. M. and four, A. M.

Section 4. All dead animals must be promptly and properly buried and in such places that the public health shall not be endangered thereby.

Section 5. In any cases of death from small-pox, diphtheria, scarlet fever or typhus fever, a public funeral will not be permitted, and the burial shall be conducted in such a manner as not to expose the people to contagion more than is absolutely necessary.

Section 6. All sink drains from premises upon streets where there are public sewers are required to enter such sewers.

Section 7. All houses and premises within the jurisdiction of this board must be kept clean, and anything that tends to constitute a source of danger to public health must be kept promptly removed.

BINGHAM.

1894. Two nuisances were removed. It has been an unusually healthy year, with not a single case of infectious disease to our knowledge. A sewerage system is greatly needed in the village.

1895. We had only one case of scarlet fever and one of typhoid fever.—T. F. Houghton, Sec.

BLAINE.

1894. Three nuisances were removed. One of the nuisances abated was the practice maintained by a butcher of slaughtering animals in a stable connected with his house in the village. We had seven cases of typhoid fever. Pneumonia prevailed in March and April, and diarrheal diseases of children in July, August and September.

1895. One nuisance was abated. One case of scarlet fever and six of typhoid fever. All cases of contagious diseases were confined to the premises.—G. F. Carsley, Sec.

BLANCHARD.

1894. We have had no infectious diseases, but there were two cases of bowel trouble in August due, as we think, to polluted water.

1895. No cases of contagious diseases.—E. P. Blanchard, Sec.

BLUEHILL.

1894. Fourteen cases of scarlet fever and four of typhoid. The law has been carried out as recommended by the State Board of Health. Better drainage and better ventilation in schoolhouses and public buildings are needed.

1895. Twelve cases of scarlet fever and six of typhoid. Every precaution has been taken to keep the disease from spreading after the board has been notified. Scarlet fever broke out in the schools several times. The schools were closed and every precaution was taken to prevent the disease from spreading.—Dr. R. P. Grindle, H. O.

BOOTHBAY.

1894. We had no cases of infectious disease, with the exception of four of typhoid fever. It has been the healthiest year for fifty years: there were eighteen deaths in town, eight were over seventy years of age.

1895. One nuisance was abated. Three cases of typhoid fever.—Dr. Alden Blossom, H. O.

BOOTHBAY HARBOR.

1894. Two nuisances reported to the board were removed. One case of scarlet fever and seven of typhoid. It has been remarkably healthy for the past year: of fifty deaths in Boothbay and Boothbay Harbor, twenty-one of the persons were over sixty, and twelve were over seventy years of age.

1895. During the year a water supply has been put into the village at an expense of $50,000. Two cases of typhoid fever. With this exception, there have been no cases of infectious diseases.—Dr. Alden Blossom, H. O.

BOWDOIN.

1894. We have had no cases of contagious disease.

1895. One nuisance was removed. Two cases of scarlet fever, but nothing else in the way of infectious diseases.—Thos. F. Rand ,Sec.

Bowdoinham.

1894. We had three cases of typhoid fever, and measles and whooping cough were present. A better location of wells and a better construction and management of privies would work an improvement in the health conditions of our town.—Dr. I. C. Irish, Sec.

Bowerbank Plantation.

1894. One death occurred from consumption. No contagious diseases.—Edward Clarke, Sec.

1895. No contagious diseases.—Chas. S. Jenkins, Sec.

Bradford.

1894. Five cases of typhoid fever. In one family in this town, in the fall of 1894, there was an outbreak of typhoid fever. The family water supply was obtained from a well located in an old shed in the barn-yard: in the well was an old rotten wooden pump. Water was obtained from the well by means of a bucket, the pump being broken and useless. Cans of milk were kept in the well to cool. The pig-pen was but a few feet away, and the barnyard drainage and filth surrounded the well.

Analysis No. 968 was of a sample of water from this well. The report of the results is given among the notes on analyses. See paging.

1895. One case each of scarlet fever and of typhoid fever.—Dr. S. Prescott, Sec.

Bradley.

1894. Two nuisances were removed. No infectious diseases.—John H. Knapp, Sec.

Bremen.

1895. No infectious diseases.—W. B. Hilton, Sec.

Brewer.

1895. Six or eight hundred feet of sewers have been added to our system since the last report. Three nuisances were reported to the board, two of which were removed. The unabated

one was due to the need of a sewer. We had eight cases of scarlet fever. German measles have been prevalent. A pure water supply and more sewers are needed to improve the sanitary condition of the city.—W. H. Gardner, Sec.

BRIDGTON.

1894. Four nuisances reported to the board were all removed. All directions given by the local board of health have been promptly obeyed, and I think our town is in a very healthy condition. Two cases of typhoid fever.

1895. We have had one case of typhoid fever and an epidemic of whooping cough, fifty-four cases in all.—Isaiah S. Webb, Sec.

BRIGHTON PLANTATION.

1894. One case of typhoid fever. Pneumonia was prevalent from January to April.—E. A. Decker, Sec.

1895. Two nuisances were removed. No infectious diseases.—Dr. J. C. Adams, Sec.

BRISTOL.

1894. No cases of infectious diseases, save one of diphtheria. We have had a very satisfactory state of health for the year. Very little sickness has occurred. Summer residents complain somewhat of the fertilizer factories, but the best of health has reigned all about them and we can take no action.

1895. Two nuisances reported to the board were removed. One case of diphtheria and three of typhoid fever. Prompt action is taken in these cases.—Geo. E. Little, Sec.

BROOKLIN.

1894. One case of diphtheria was reported, but proved to be tonsilitis. The house, however, was isolated promptly until the patient was convalescent. One case of typhoid fever, and this was imported. Infectious diseases are promptly isolated, and all the prescribed precautions taken to prevent the spread of contagion. Dr. Herrick, who has practiced in this town for about ten years, says he has not yet had a case of diphtheria.

We think our town remarkable for the health of its people and its general sanitary correctness.

1895. We have had seven cases of measles and five of scarlet fever. As usual, houses have been placarded and isolation maintained. On account of scarlet fever in one school, the school was closed, all the books were burned and the school building was thoroughly disinfected.—E. P. Cole, Sec.

BROOKSVILLE.

1894. Three cases of scarlet fever and five of typhoid. These have been carefully looked after.

1895. With the exception of one case of typhoid fever, and mumps in April, we have been free from infectious diseases. The past year has been a very healthy one.—O. L. Tapley, Sec.

BROOKTON.

1894. We have had eight cases of scarlet fever. Placarding and quarantine have been carried out, as usual.—G. A. McCluskey, Sec.

BROWNFIELD.

1895. Two nuisances were removed. There were several cases of typhoid fever. No action was taken in these cases further than giving instruction in regard to the disinfection of discharges and general precautions.—Dr. H. F. Fitch, Sec.

BROWNVILLE.

1894. Some improvements have been made in the water supply. About eighteen families are now supplied with spring water. Four nuisances reported to the board were all removed. We had no infectious diseases.

1895. All nuisances have been taken care of. Three cases of diphtheria and four of typhoid fever.—T. W. Pratt, Sec.

BUCKSPORT.

1894. Four nuisances reported to the board were all removed. We had twenty cases of scarlet fever and three of typhoid. Houses and inmates were quarantined and thorough

disinfection was carried out. A complete system of sewerage is needed.—Dr. H. E. Snow, H. O.

1895. A sewer the length of one street, about 50 rods, has been put in. Another sewer on the principal street was rebuilt. Of eight nuisances reported, seven were fully removed and one, partly. Diphtheria, one case; scarlet fever, three; typhoid, two. Whooping cough in the fall.—H. E. Marks, Sec.

Burlington.

1894. Three nuisances reported were removed. Thirty-two cases of scarlet fever and two of typhoid. We voted to divide the town into three districts and that each member of the board look after matters in his own part.

1895. Four nuisances were removed. We have had no cases of infectious diseases.—Thos. Shorey, Sec.

Burnham.

1894. Two cases of typhoid fever, but in a light form. No other infectious diseases.

1895. Three cases of diphtheria, one of scarlet fever and two of typhoid fever. Houses were immediately placarded and all communication with the houses stopped. In every case the disease has been kept within the house where it originated. One death from a kerosene accident happened. A man accidentally set fire to a barn and was fatally burned.

The following seems to be a plain case of tubercular contagion from husband to wife:

A Mr. G., about forty years of age, was sick with tubercular consumption. His wife, a woman about thirty years of age, very healthy and robust, the very picture of health, took care of him, sleeping with him, or in the same room, all the time until his death. Very soon afterward she began to cough and continued to grow worse until she finally died with the same disease. —N. E. Murray, Sec.

Buxton.

1894. About twelve nuisances were reported to the board, all of which were removed. Diphtheria, one case; typhoid

fever, one. The precautions suggested by the State Board have been observed.

There has been quite an epidemic among horses, sore throat, loss of appetite, swelling of the glands under the tongue, and a profuse discharge from the nostrils were the symptoms. The disease lasted about fourteen days, and a slow convalescence followed.—Dr. C. A. Dennett, H. O.

1895. A swampy place at West Buxton was tile drained and covered. Eight nuisances reported to the board were removed. Two cases of diphtheria. The houses were visited by the health officer, circulars were distributed, cases were isolated and houses were disinfected at the proper time.—Dr. A. W. Weeks, Sec.

Byron.

1894. One case of scarlet fever and one of typhoid fever.

1895. One nuisance was removed. Two cases of typhoid fever. The cases of typhoid fever appear to have been caused by the polluted water of Swift River which is used for drinking purposes. The pollution was caused by Italians camped on it, building a railroad.—H. H. Richards, Sec.

Calais.

1894. Eleven nuisances were removed, only one of which gave difficulty in securing abatement. One case of diphtheria and nine of scarlet fever. In connection with infectious cases as rigid quarantine and perfect isolation as the conditions will permit are established, and thorough disinfection is carried out. Improvements in sewerage are needed.—Dr. D. E. Seymour, Sec.

1895. The number of takers of the city water supply have been increased, and a few wells have been filled or covered. Of nine nuisances reported to the board five were abated. Three cases of diphtheria, six of scarlet fever and five of typhoid fever. Two cases of typhoid fever we think resulted from polluted wells. Better sewers are needed.—Dr. J. B. Woods, Sec.

CAMBRIDGE.

1894. No cases of infectious disease, except one of typhoid fever.—S. G. Quimby, Sec.

1895. We had no cases of contagious diseases.—Joseph J. Chadbourne, Sec.

CAMDEN.

1894. Of ten nuisances coming to the knowledge of the board, eight were removed. We had seven cases of diphtheria, all in one house. The house was quarantined and everything was done as the law requires to prevent the extension of the disease. More sewerage is needed in the town.

There should be a law against dumping dead horses and other animals into our bays and harbors. We have had four come ashore this year, and three last year. As nearly as we can find out, three of them came from towns above us.

1895. Ten nuisances out of the eleven were abated. We had one case of diphtheria, one of membranous croup and two of typhoid fever. Measles and whooping cough were also present. On account of a case of diphtheria, one of the primary schools was closed for one week.—A. Buchanan, Sec.

CANAAN.

1894. Two nuisances were removed. We have had no cases of infectious disease.

1895. A portion of the town has been supplied with water from a spring a short distance from the village. We have had no contagious diseases.—Dr. Ivory Lowe, H. O.

CARIBOU.

1894. A comprehensive system of sewers was begun last summer after a full survey, and will, I think, be largely extended during the year 1895. Of eighteen nuisances coming to the knowledge of the board, seventeen were removed. Sometimes it has been difficult to close dangerous wells and springs. We had no cases of diphtheria or scarlet fever, but there were twenty-two cases of typhoid fever. Diarrheal diseases were

almost absent in spite of the greatest and most prolonged drouths of the century. Why? In one case typhoid fever seemed to arise from infected rooms after six or more months.

1895. Ten nuisances were removed. One case of scarlet fever and nine of typhoid.—Dr. Jefferson Cary, Sec.

CARMEL.

1894. One nuisance was removed. Two cases of scarlet fever and eight of typhoid.

1895. We have had no cases of infectious diseases, with the exception of measles in July. The board provided free vaccination, employing a competent physician to do the work.—F. A. Simpson, Sec.

CARROLL.

1894. We have had no cases of infectious diseases.

1895. Two nuisances were removed, but there have been no cases of infectious disease, except whooping cough from June to September, and German measles.—E. W. Thibodeaux, Sec.

CARTHAGE.

1894. We have had no cases of contagious diseases.—C. F. Eaton, Sec.

CASCO.

1894. One nuisance was removed. Three cases of scarlet fever. The house was quarantined until the patients recovered, and then the rooms and the attendants were disinfected when their liberty was recommended by the attending physician. Measles in the summer and fall.—Dr. L. H. Poor, Sec.

1895. Two nuisances removed. Two cases of typhoid fever. Measles the first of the year and whooping cough in the summer.—Dr. Walter Corliss, Sec.

CASTINE.

1894. The Castine Water Company has laid water pipes through the principal streets, and built a reservoir with the capacity of 600,000 gallons. This is to be filled from an artesian well, the water raised by a double windmill.

The State has put in a six inch sewer pipe that runs down Main street to low water mark, connecting with the Normal School and quite a number of houses and one hotel are accommodated by it. Seven nuisances were removed. One case of diphtheria, fourteen of scarlet fever and one of typhoid fever. Prompt quarantine of all in the family except the bread-winner, isolation as far as possible, placarding houses, and disinfection were measures used against the spread of infection. Whooping cough in the fall. More sewers are needed.

1895. An improvement in the sanitary conditions of the town has been made by the building of the new water works, by the supplying of some forty families with pure water. Six nuisances were removed. No contagious diseases, with the exception of one case of diphtheria which was promptly isolated and looked after.—Dr. S. J. Wallace, Sec.

Castle Hill Plantation.

1894. We had seven cases of scarlet fever and four of typhoid fever. In these cases the board at once took every possible step to prevent the spread of the infection.

1895. One case of typhoid fever.—Dr. Charles E. Dow, Sec.

Centerville.

1894. Two nuisances were removed. Chicken-pox was the only infectious disease in the town.—Willis Caler, Sec.

1895. We have had no infectious diseases.—Freeman Rice, Sec.

Chapman Plantation.

1894. Only one case of typhoid fever, and no other infectious diseases.

1895. Two cases of typhoid fever, and two or three cases of whooping cough in one family.—E. C. Cook, Sec.

Charleston.

1894. One nuisance was abated. No infectious diseases during the year. This is one of the healthiest towns in the State, so far as my observation goes. The surface is hilly and undu-

lating, with numerous springs of pure water. There is not much flat and boggy land, but the water is freely conveyed to the lakes and larger streams by numerous smaller streams and brooklets. Orchards are numerous and fruit is abundant, especially apples, and this feature alone, it is said, will beggar the doctor almost anywhere.

The teachers should be taught the principles of hygiene and the importance of ventilation, and should be made to look after these matters more carefully.

1895. Four cases of typhoid fever. These were attended to at once.—Dr. G. B. Noyes, H. O.

CHARLOTTE.

1895. No cases of infectious diseases of any kind have been known.—F. J. Sprague, Sec.

CHELSEA.

We have had no cases of contagious diseases.—W. T. Searls, Sec.

CHERRYFIELD.

1894. One nuisance was abated. Twenty-six cases of scarlet fever, only one of which was fatal.

1895. No cases of diphtheria or typhoid fever, but six of scarlet fever, and whooping cough was prevalent in December. —Dr. C. J. Milliken, Sec.

CHESTER.

1894. No infectious diseases, except one of typhoid fever.

1895. Two cases of scarlet fever in one house. All precautions were taken to prevent the spread of the disease, and all clothing was disinfected. These scarlet fever cases appear to have been brought from a town in Aroostook county. A family came here in which there had been sickness before they moved into our town. They supposed that the disease was scarlet rash, but, in all probability, the disease in our town was taken from their clothing.—J. D. Kyle, Sec.

(Scarlet fever, scarlet rash, canker rash and scarlatina are several names for one and the same disease, and the same precautions should be taken for all alike.—A. G. Y.)

CHESTERVILLE.

1894. No cases of infectious disease. A physician was engaged to vaccinate all who wished it.

1895. Still again no diseases to report.—S. T. Grant, Sec.

CHINA.

1894. Three cases of diphtheria. One case of scarlet fever. Immediately upon notice, the secretary visits the infected house, placards the house and gives all necessary instructions regarding the restriction of the disease, isolation, etc.

1895. Two nuisances were reported, one of which was abated and the other was investigated and found not to be a nuisance. Three cases of varioloid, ten cases of diphtheria, one of scarlet fever, and one of typhoid. We have more contagious diseases to report for the year past than for any previous year since the organization of our board. In no case since the organization of this local board has a case of infectious disease extended beyond the house in which it originated.—Dr. G. J. Nelson, Sec.

CLIFTON.

1894. A few cases of mumps are all in the line of infectious diseases that I can report.—H. G. Doble, Sec.

1895. No infectious diseases.—Frank Humphrey, Sec.

CLINTON.

1894. Four nuisances were abated, one of which, a slaughter house, made some trouble for the local board. No infectious diseases, with the exception of whooping cough in the autumn.

1895. Five nuisances reported, were all removed. The worst one originated in a tannery, the waste from which goes to a stream which flows through one corner of the village. The water at some of the time had a fearful stench. We had the stream cleaned out, the banks scraped, and dumped in six casks of lime. We are fearful that next year it will be worse. We have had a dam built above the tannery, and hope it will hold back enough water to clean out the stream in dry time. No

infectious diseases except one case of typhoid fever.—Dr. A. A. Shaw, Sec.

Columbia.

1894. We have had a very small amount of sickness in our town this year, only one case of scarlet fever among the infectious diseases.

1895. No infectious diseases.—John E. Stewart, Sec.

Columbia Falls.

1894. One nuisance was reported, and this was removed. No infectious diseases. One case of severe burning in a barn resulted from an accident with a lantern.

1895. No contagious diseases.—Dr. E. A. White, Sec.

Concord.

1894. One nuisance was removed. No cases of diphtheria, scarlet fever or typhoid.

1895. This year among the infectious diseases, only measles in July and August, and whooping cough in November and December. Measles was brought into town by a young man coming home sick from Boston, where he had been at work, not knowing what was the matter until a number of persons had been infected.—E. O. Vittum, Sec.

Connor Plantation.

1895. No cases of infectious diseases reported.

Cooper.

During the two years there were no cases of infectious diseases.—Willis G. Day, Sec.

Corinna.

1894. A water supply for the village has been brought from some nice springs nearly one-half mile away. A sewer has been put into Hancock street. Two nuisances were removed. One case of typhoid fever.—J. P. Curtis, Sec.

1895. One nuisance removed. No disease has been particularly prevalent.—Dr. J. A. Tabor, Sec.

Cornish.

1894. With the exception of chicken-pox, and a cough which some called whooping cough, there were no infectious diseases.

1895. No infectious diseases reported to the board.—Howard Brackett, Sec.

Cornville.

1894. Cornville has no village, and I am glad to report that it has been a very healthful year and we have had almost nothing to do.

1895. No infectious diseases this year, with the exception of one case of diphtheria. The board tries to do its duty.—S. S. Woodman, Sec.

Cranberry Isles.

1894. One sewer was put in to the sea. Two cases of typhoid fever in a light form. One case of scarlet fever.

1895. One nuisance removed. One case of typhoid fever. An influenza epidemic during the summer.—Wm. P. Preble, Sec.

Crawford.

It has been very healthy for two years, with no cases of contagious diseases.—J. P. Jeffery, Sec.

Cumberland.

1894. One nuisance removed. Diphtheria, two cases; scarlet fever, five; typhoid fever, two. Measles in April and May, and whooping cough in the fall and early winter.

1895. One case of diphtheria, seven of scarlet fever and one of typhoid fever.—Dr. H. M. Moulton, Sec.

Cushing.

1894. Diphtheria, six cases; typhoid fever, one. The precautions required by the law are observed. The sanitary condition of the town would be improved by ventilating the cellars, and by drainage.

1895. No infectious diseases are reported.—A. R. Rivers, Sec.

CUTLER.

1894. One nuisance abated. No infectious diseases. It has been a very healthy year.

1895. Only whooping cough in the fall, as an infectious disease. Our sanitary condition is good.—Geo. Gardner, Sec.

CYR PLANTATION.

1894. There have been no contagious diseases. Cholera infantum was prevalent in July and August.—Francois Cormier, Sec.

DALLAS PLANTATION.

1895. No infectious diseases reported.—Mrs. Ella G. Adams, Sec.

DAMARISCOTTA.

1894. One nuisance was removed. No cases of diphtheria or typhoid fever, but there were three of scarlet fever. The precautions taken were notifications, distributing of the proper circulars, and placarding of the houses. A more careful management of sink spouts, privies, etc., would improve the sanitary condition of the town. Free vaccination was provided, but the people did not avail themselves of it as they ought.

1895. No cases of contagious diseases to report this year. A water supply is needed, and we are striving for it.—A. H. Snow, Sec.

DANFORTH.

1894. Four nuisances removed. One case of diphtheria and that was attended to in accordance with the requirements of the law. It has been a very healthful year, but better drainage is needed in the village.

1895. Four nuisances, all of which were removed. The worst cases we have to contend with are sink spouts and places where waste water is thrown out. No infectious diseases, except one of scarlet fever.—Dr. M. L. Porter, Sec.

DAYTON.

1894. One case of typhoid fever. We think there should be more definite provisions made for those families who are kept

under quarantine for a long time, as it is often necessary in cases of contagious diseases.

1895. Two nuisances removed. One case of typhoid fever. We have been quite free from contagious diseases the past year, with the exception of one severe case of typhoid fever which was evidently contracted away from home in a city.

Several schoolhouses are in a bad location as regards drainage, but no contagious diseases have entered the schools.—Dr. Geo. Sylvester, Sec.

Dead River Plantation.

For the two years we have had no cases of contagious diseases. The sanitary condition of the place is good, and everybody is in perfect health.—S. A. Parsons, Sec.

Deblois.

1894. No contagious diseases during the year.—D. F. Libby.

Dedham.

1894. Whooping cough prevailed in September and October.

1895. There has not been a case of contagious disease in town the past year.—J. E. Turner, Sec.

Deering.

1894. Sewers have been quite extensively introduced. Twenty-nine nuisances were attended to by the board, all of which were abated without much trouble. We had two cases of diphtheria, fourteen cases of scarlet fever from February to June, and fifteen cases of typhoid fever from September to November.

The board was notified by the physicians who attended the several cases of the contagious diseases, and prompt attention was given to each case by the board in quarantining the house and taking other measures to keep the disease from spreading.

1895. Twenty-six nuisances were reported to the board and were disposed of without trouble, with the exception of one case which was submitted to legal authority for adjustment.

We had fourteen cases of diphtheria (eleven houses), also fourteen cases of scarlet fever (eleven houses), and eighteen cases of typhoid fever (fifteen houses). At the present date there are no known cases of contagious diseases.—Geo. Russell, Sec.

Orders of the Board of Health of the city of Deering, Me. Adopted May 26, 1890.

1. No sink, bath-tub, water-closet, privy, cesspool, or place of accumulation of offensive liquid matter, shall be allowed to drain into any lane, street or highway.

2. Any accumulation of refuse matter, such as swill, waste of meat, fish or shells, bones, decayed vegetables, dead carcasses, excrement, or any kind of offal which may decompose and generate disease germs or unhealthy gases, and thus affect the purity of the air in the immediate vicinity of any dwelling-house or place of business, shall be considered a nuisance, and must be removed or disposed of either by burial, burning or otherwise, and in such manner, that it may not be offensive to the neighborhood wherever located.

3. No night-soil, sewage, contents of privy vaults or cesspools, or other noisome substance, shall be deposited in any place, or used as manure or fertilizer in such way or manner, as shall be detrimental to life or health, or offensive to the neighborhood wherever located.

4. Whenever a privy vault shall have been removed by order of the board of health, or otherwise, the premises shall be supplied with a suitable water-closet, which, in respect to its water-flush, shall be satisfactory to the board of health.

CHAPTER 123, PUBLIC LAWS OF 1887.

Section 26. Any person who shall wilfully violate any of the provisions of this act or of said regulations and by-laws, the penalty for which is not herein specially provided for,—and any person who shall wilfully interfere with any person or thing to prevent the execution of the provisions of this act or of said regulations and by-laws, shall be guilty of a misdemeanor, and

upon conviction thereof, shall be subject to a fine of not more than fifty dollars.

F. D. COLEMAN,
GEO. RUSSELL,
A. F. BERRY,
Board of Health.

Approved May 26, 1890.
C. W. WALTON, Justice Supreme Judicial Court.

Orders and By-Laws of the Local Board of Health of the city of Deering, Maine.

Section 1. The Secretary of the Board shall have power and authority, and it shall be his duty, to enforce all Laws, Orders and Regulations of the Board relating to causes of sickness, nuisances, and sources of filth in the city.

Section 2. On and after the 21st day of May, 1895, no person shall be allowed to construct any privy-vault, cess-pool, or any other receptacle or conductor for drainage for filth of any kind in any locality within the city limits when access can be had for drainage to a public sewer. When upon proper complaint made in writing to the Board of Health, any privy-vault, cess-pool, receptacle or conductor constructed or used prior to the adoption of these orders, shall after careful and thorough investigation be adjudged by the Board of Health to constitute a nuisance or a source of danger to the public health, such privy-vault, cess-pool, or receptacle or conductor shall forthwith be discontinued and abolished, when the premises upon which said nuisance exists can be connected with the public sewer. When such nuisances exist in localities unprovided with proper street sewers, such disposition shall be made of them as the Board of Health may determine.

Section 3. Whenever it shall appear to the board of health that any cellar, lot or vacant land is in a state of nuisance, or so situated that it may probably become dangerous to the public health, the board, through its secretary, shall cause the same to be drained, filled up or otherwise prevented from becoming or remaining a cause of nuisance or sickness. The secretary

shall charge all reasonable expenses incurred in so doing to the several owners or parties occupying such cellar, lot or vacant land; provided, notice shall first have been given, and suitable time allowed for said owners or partics to abate said nuisance.

Section 4. All stable manure and dressing shall be removed beyond the limits of the thickly populated portion of the city as often as once in every four weeks of each year during the months of May, June, July, August and September. And in stables where four or more horses and cattle are kept such manure and dressing shall be removed as aforesaid as often as once in every two weeks during same months. Provided, however, that any manure or dressing shall be removed as aforesaid at any time when deemed by the board of health reasonably necessary. When the owner, agent or occupant of premises, after twenty-four hours written notice from the secretary of the board of health to remove any manure or dressing as aforesaid, refuses or neglects to comply with the directions given in said notice, the secretary shall remove the same at the expense of the owner, agent or occupant.

Section 5. No swine of any kind shall be kept hereafter within the limits of the thickly settled parts of the city during the months of May, June, July, August and September. Anyone not complying with the requirements of this section shall be subject to a penalty of one dollar per day for every swine kept in violation thereof.

Section 6. Service of any notice under these orders and by-laws may be executed by the secretary or by any officer who may execute civil process.

Section 7. It shall be the duty of the secretary of the board of health to keep an exact account of all costs, outlays and expenses that may be incurred in carrying into effect any of the purposes and provisions set forth or contained in any of the sections of these orders and by-laws, and without delay to report the same to the city auditor of accounts with the name of the various persons to whom they may be chargeable, and the proportion or amount payable from each person.

The city auditor shall examine, correct and charge the same in his books, and without delay make out bills therefor accordingly, and place said bills in the hands of the city treasurer for collection.

Section 8. The board of health or secretary thereof may employ and hire such help as is necessary for carrying into effect any of the orders or regulations of the said board.

Approved May 21, 1895.

C. W. Walton, Justice Supreme Judicial Court.

Deer Isle.

1894. Seven cases of diphtheria (one house), six cases of scarlet fever (two houses), seven cases of typhoid fever (two houses).

1895. One nuisance was removed. Two cases of scarlet fever (two houses), two cases of typhoid fever (two houses). Contagious diseases are attended to at once.—A. J. Beck, Sec.

Denmark.

1895. Four nuisances were removed. We have had no contagious diseases. My attention was called to the condition of our high school building. The water-closets were under the same roof with the school rooms. I recommended their removal, and the school committee has promised that they shall be removed before the spring term begins.—Dr. S. T. Brown, Sec.

Dennistown Plantation.

1894. We have had no contagious diseases.—Geo. Henderson, Sec.

1895. This place has been nearly free from sickness and accidents the past year. There have been no contagious diseases.—Moses Holden, Sec.

Dennysville.

1894. One case of diphtheria, four cases of scarlet fever (two houses). Houses were placarded and families kept from the public as much as possible.

1895. We have had no infectious diseases excepting one case of typhoid fever. The person who was sick with this disease had been visiting ten miles away where they were sick of typhoid fever.—Fred L. Gardner, Sec.

DETROIT.

1894. We had six cases of typhoid fever (six houses). The typhoid fever was supposed to have been caused by the eating of infected oysters.

1895. We have had no infectious diseases, with the exception of mumps.—David F. Libbey, Sec.

DEXTER.

1894. Eight nuisances were removed. Five cases of typhoid fever (three houses). One case of suspected glanders reported to this board was referred to the cattle commissioners. The horse was quarantined ten days, and then the disease was pronounced catarrh.

1895. Five nuisances were removed. Eight cases of typhoid fever (five houses). Sewerage is needed to improve the sanitary condition of the town.—Edgar A. Russ, Sec.

DIXFIELD.

1894. Part of two streets in the village has been drained of surface water by means of open and covered ditches and with large sized drain tiles. One case of scarlet fever and one of typhoid. The secretary was called in the morning to see a child who, the day before, had a headache in the afternoon in the village school, and was taken violently sick in the evening. The case indicated scarlet fever so strongly that no time was lost in closing the school. The scholars were instructed to remain strictly at home. The next day the disease was found to be scarlet fever. With the strict quarantine of the infected house and thorough disinfection of the patient, clothing, etc., we escaped with this single case. The child was not permitted to return to school until more than six weeks had elapsed.

1895. Two nuisances were removed. Seven cases of typhoid fever (six houses). Four of the cases of typhoid fever were

brought home sick from another town where they had been at work.—Dr. J. S. Sturtevant, Sec.

Dixmont.

1894. One case of typhoid fever. It was treated by disinfection of the excreta and the boiling of the clothing. No other contagious diseases, with the exception of *la grippe* and mumps.

1895. Two nuisances abated. No infectious diseases excepting whooping cough in February and March, and two cases of measles in school children. They and others from the same family were kept from the school, and no extension of the disease followed.—Dr. E. E. Brown, Sec.

Dover.

1895. One nuisance was abated. Two cases of typhoid fever in which immediate action was taken to prevent the spread of the disease. We have had no epidemics nor unusual amount of sickness during the year. Better sewerage is needed in the village.—Geo. G. Downing, Sec.

Dresden.

1894. One case of diphtheria, in which the board complied with the requirements of the law. Measles was prevalent and mumps.

1895. Two cases of typhoid fever (two houses). Action was taken to restrict the disease to the houses in which it occurred.—Dr. L. H. Dorr, Sec.

Drew Plantation.

No infectious diseases in either year.—Chas. R. Andrews, Sec.

Dyer Brook.

1894. No contagious diseases were reported.

1895. One nuisance was reported. This consisted of several cart loads of diseased potatoes which were left near where the people hauled water from a brook during a dry season. One

case of typhoid fever. Whooping cough in December. Some of the patients from whooping cough had sore throat, weak eyes and jaundice when they began to improve. The schoolhouse privies have been looked after closely. It would improve the sanitary condition of the town if all waste matter were burned.—John L. Moulton, Sec.

EAGLE LAKE PLANTATION.

1894. We have had no cases of infectious diseases.—J. M. Brown, Sec.

EASTBROOK.

1894. One case of scarlet fever. The house was placarded and the necessary means used in cleansing.

1895. No cases of infectious diseases.—A. P. Bunker, Sec.

EAST LIVERMORE.

1894. Seventeen nuisances were removed. One case of diphtheria, one of typhoid fever and sixty cases of scarlet fever (forty-six houses).

1895. Three nuisances removed. One case of diphtheria, twelve of scarlet fever (twelve houses), one of typhoid fever.—S. A. Nelke, Sec.

EAST MACHIAS.

1894. One case of diphtheria, about thirty of scarlet fever (fifteen houses). Scarlet fever appeared in one of the schools and, upon my advice, the school was closed until the spread of the disease was stopped.

A man reported a disease among his cattle, last summer, which seemed like tuberculosis. I advised them to boil the milk before using it, and this they have done ever since. The cattle commissioners were notified, but replied they had no funds to carry on their work.

1895. Nine nuisances were removed. Two cases of diphtheria (two houses), four cases of typhoid fever (two houses). Dysentery was very prevalent in August, September and October. I believe that our epidemic of this disease was caused by bad hygienic surroundings, as it started in a low, badly drained part of the town.—Dr. John A. McDonald, H. O.

Eastport.

1894. Thirty or forty nuisances were abated. We had two cases of typhoid fever. A system of public sewers is needed.

1895. Only one case of typhoid fever. One horse was shot on account of having glanders.—H. H. Wadsworth, Sec.

Eddington.

1894. Seven cases of typhoid fever (three houses). Four of the cases of typhoid fever were contracted out of town.

1895. This has been the most healthy year since the organization of the board; no sickness, no accidents; and this is very gratifying to the local board of health.—D. S. Stevens, Sec.

Eden.

1895. Three cases of scarlet fever (three houses); seven of typhoid fever (three houses).—C. R. Clark, Sec.

Edgecomb.

1894. One nuisance was abated. One case of typhoid fever in which such action was taken as the law provides. A few cases of measles caused the closure of one school. It has been a general time of good health throughout the year.

1895. One nuisance removed. Three cases of scarlet fever (one house); one case of typhoid fever. One case of tuberculosis in a cow. The animal was destroyed by order of the State Veterinary Surgeon.—Eben Chase, Sec,

Edinburg.

1894. No contagious diseases. 1895. Only one case of typhoid fever; no other infectious diseases.—C. W. Eldredge, Sec.

Edmunds.

1894. One nuisance removed. One case of typhoid fever. The precautions taken were thorough cleansing and disinfection.

1895. I am very much pleased to report the unusually healthy state of our town during the past year. There has not

been a case of any kind in which the board has been called upon. There has been one fatal case each of pneumonia and of cholera morbus.—C. W. Hobart, Sec.

Eliot.

1894. Scarlet fever, two cases (one house); typhoid fever, one case. We have had no unusual outbreak of disease excepting winter cholera.

1895. Two nuisances were removed. Twelve cases of scarlet fever (five houses); one case of typhoid. Eleven of the twelve cases of scarlet fever occurred in one school. A pool of stagnant water near this schoolhouse was drained by order of the board. The sanitary condition of our town is very good, as is shown by our comparative immunity from typhoid fever and other diseases.—Dr. H. I. Durgin, Sec.

Ellsworth.

1894. Twelve nuisances reported to the board, of which nine were abated. We have had three cases of typhoid fever (three houses). Measles occurred in the spring. A system of sewerage is needed.

1895. Six nuisances were removed. Two cases of scarlet fever (two houses); three cases of typhoid fever (three houses). A strict quarantine was observed. Whooping cough occurred in the late fall and early winter. Several cases occurred in elderly people, most of whom affirmed it to have been a second attack. Scarlet fever cases were limited, so far as I can learn, to the place of their origin. A beef, reported to have suffered from cancer while alive, is said to have been marketed.

The body of a supposed diphtheria patient was shipped from New York. The casket was with glass so arranged as to expose the features. The funeral was to have been public, but the board requested it to be private. Had the board authority to *demand* it to be private, provided it was true diphtheria? The death certificate read, "La grippe with acute sore throat." In the latter case should the board have taken any notice of the funeral whatever?—Dr. Lewis Hodgkins, Sec.

(Answer, February 24, 1896. "Referring to the query on the blank which brings your annual report, I would say that it seems to me you had good reason to believe that the person of whom you write died of diphtheria, and, believing so, I think you had ample authority under the third sub-section of section 7, page 2, of Abstract of the Health Laws, not only to advise a private funeral, but to demand it, providing that such action had been necessary. If it should be objected that you had no proof that the disease was true diphtheria, you could, nevertheless, affirm that acute sore throats that kill are infectious almost invariably, and that there is ample testimony now that *la grippe*, or influenza, is an infectious disease. Whether or not the person died of diphtheria, he undoubtedly died of a contagious or infectious disease, and I think you did right in providing for a private funeral. Of course it is better to arrange these matters in the form of a request when that is practicable." —A. G. Y.)

EMBDEN.

1894. Three nuisances removed. Seven cases of scarlet fever (three houses). The families were quarantined and the houses disinfected. It was the opinion of the attending physician that the disease originated by the children unpacking clothing which had formerly been used by a patient who had scarlet fever.

1895. One nuisance removed. No infectious diseases.—Fred H. Dunbar, Sec.

ENFIELD.

1894. No nuisances, excepting that bushels of eels, in September, were caught up by the water wheels of the pulp mill on the main river and drifted in on the shores, which was offensive to some, and we had the factory agent remove them.

Seven cases of scarlet fever (six houses). Whether cases of infectious diseases are reported or not, I go as soon as I hear of the case and see that the children are kept at home and that other families keep away, unless their assistance is actually needed.

1895. Six cases of scarlet fever (four houses).—A. J. Darling, Sec.

ETNA.

1894. Two cases of typhoid fever.—A. R. Sylvester, Member of the board.

1895. We had no cases of infectious diseases. The condition of our town, the past year, has been good from a sanitary point of view, and has required but little work on the part of the board.—Stillman J. Locke, Sec.

EUSTIS.

1894. One nuisance removed. Fourteen cases of scarlet fever (nine houses). On account of the cases of scarlet fever the schools were suspended.—O. A. Hutchins, Sec.

1895. One nuisance was removed. No infectious diseases have been reported to the board.—Dr. T. W. Brimigoin, Sec.

EXETER.

1894. One nuisance removed. One case of typhoid fever.

1895. Three cases of typhoid fever. Infectious cases are looked after by the board.—E. J. Ames, Sec.

FAIRFIELD.

1894. Nine nuisances were removed. Eight cases of diphtheria (seven houses); one of typhoid fever. Better sewerage is needed.

1895. Twenty nuisances were reported, nearly all of which were abated. Sink-spouts and water-closet nuisances have been the hardest we have had to deal with, as we have no system of sewerage; that is what we need. Five cases of diphtheria (five houses), but no cases of scarlet fever or typhoid fever reported. Whooping cough was present. We have attended to all calls promptly.—Geo. C. Eaton, Sec.

FALMOUTH.

1895. One nuisance was removed. Five cases of diphtheria (four houses); one case of scarlet fever, and two of typhoid

fever (two houses). Houses were quarantined, placards put on the doors, etc. Whooping cough appeared in some sections.—Henry J. Merrill, Sec.

FARMINGDALE.

1894. One nuisance was removed. One case of scarlet fever. The State laws have been fully enforced. It has been very healthy this year.—Dr. F. M. Putnam, Sec.

1895. One mild case each of diphtheria and of scarlet fever. Houses were well attended to, so well that these diseases did not affect anybody else.—John H. Burnham, Sec.

FARMINGTON.

1894. We had nine cases of diphtheria (three houses), and two cases of typhoid fever. Houses were promptly quarantined and, later, thoroughly disinfected. Infected houses are always placarded. A system of sewerage is needed.

1895. Six nuisances removed. Eight cases of diphtheria (seven houses); six of typhoid fever (five houses). Whooping cough caused the closure of one school. The town has voted to have a survey made for a system of sewerage.—Dr. F. O. Lyford, H. O.

FAYETTE.

1894. One case each of diphtheria and scarlet fever. On account of the case of scarlet fever, one school was closed and the room was disinfected.

1895. One nuisance removed. One case of scarlet fever and one of typhoid. Our town is so situated as to surface and good water supply that it is a very healthy location.—S. B. Philbrick, Sec.

FLAGSTAFF PLANTATION.

No cases of infectious diseases either in 1894 or 1895.——John R. Viles, Sec.

FOREST CITY.

1894. With the exception of measles in March, no infectious diseases.

1895. One nuisance is caused by the spreading of fleshings from a tannery over meadows. Two cases of typhoid fever

(two houses). The board has promptly complied with the requirements of the laws of public health. Follicular tonsillitis was present in July and August.—Dr. W. A. Vanwart, H. O.

FORT FAIRFIELD.

1895. Fifteen nuisances were removed. Two only have given the board any trouble. Fourteen cases of diphtheria (four houses); thirty cases of scarlet fever; seventeen of typhoid. When these diseases have occurred, the board immediately repaired to the dwelling and placed it under quarantine, with instructions as regards sanitation, also leaving copies of health rules for distribution.

September 29, we were notified that a child was sick with diphtheria and before we could get to the house the child was dead. One physician called the disease quinsy, and another one pronounced it diphtheria. The remains were immediately buried without the attendance of the family. There were fifteen men working at this place who were completely demoralized by the news, and the board of health was obliged to state that anyone leaving the premises would be arrested. By this means the men were kept at the farm. Six more cases occurred; the wife, two little boys and three men.

The disease was brought from Tilley Settlement, N. B., by one of the men whose people had it, and he was one of the three men who had the disease. These cases were carefully watched and no cases spread from that source.

November 10, two cases of diphtheria were reported from another family. The house was quarantined, and soon three more of the children were reported sick. Of these cases, three died. This family lived in a log house with only one room 18x22 feet. The family was poor, and the citizens aided the family by furnishing food, clothing, etc. In fumigating the house it caught fire and was consumed, much to the relief of the neighbors. These cases were also traceable to the Tilley Settlement where some twenty-five cases of diphtheria occurred last fall, many of them proving fatal.

Two more cases of a mild form claimed the attention of the board, but there the matter rested; no new cases were reported.

There should be a law compelling school officers to have all schoolhouses swept out at night, so that the dust can have time to settle before the pupils enter. The dust must, of necessity, carry any germs that may be carried into the schoolroom, and this dust being taken into the lungs would tend to breed disease. —N. H. Martin, Sec.

(This is a very excellent suggestion relating to a serious fault in many of our schools.—A. G. Y.)

Foxcroft.

1894. Six nuisances were removed. Diphtheria, two cases (two houses); scarlet fever, one case; typhoid fever, three cases (two houses).—Dr. A. H. Chamberlain, Sec.

Franklin.

1894. Five cases of scarlet fever (three houses).

1895. One nuisance was removed. One case of typhoid fever. Ten cases of measles in April. A very healthy year.—Geo. U. Dyer, Sec.

Franklin Plantation.

We have been entirely free from all contagious diseases for the two years.—L. C. Putnam, Sec.

Freeedom.

1895. There is said to have been one case of typhoid fever, but none was reported. We know of no other infectious diseases.—Dr. J. W. Mitchell, Sec.

Freeman.

1894. One case of diphtheria and scarlet fever. Houses were quarantined and then disinfected.

1895. We have had no cases of infectious diseases.—N. H. Peterson, Sec.

Freeport.

1894. One nuisance which has not been abated is an open drain running from the Corner proper to the railroad track. An unbearable odor arises from it at certain times. Six cases of diphtheria (one house); twenty-six of scarlet fever (eighteen houses). A strict quarantine was placed on the houses and the inmates, and when the disease was reported ready for disinfection it has been attended to. Two schools were closed on account of scarlet fever. We shall try to get an appropriation for a sewer.

1895. Three nuisances were abated. We have had no cases of infectious diseases, excepting whooping cough in the latter part of the year.—Dr. A. R. Smith, Sec.

Frenchville.

1895. Two nuisances abated. One case of typhoid fever. Ten cases of whooping cough in December.—Dr. Isidore Coté, Sec.

Friendship.

1894. Six cases of diphtheria (four houses). Whooping cough was present.

1895. There has not been a case of contagious disease during the year.—F. G. Jameson, Sec.

Fryeburg.

1894. We have had no infectious diseases, save measles in April and May.—Dr. H. L. Bartlett, Sec.

1895. No infectious diseases.—Dr. W. C. Towle, Sec.

Gardiner.

1894. Two nuisances were removed. Three cases of scarlet fever. These cases were isolated and cared for. No disease has been unusually prevalent.—Dr. Geo. E. Friend, H. O.

1895. Seven nuisances were removed. Two cases of diphtheria (two houses). Prompt isolation and thorough disinfection by steam and other germicides. Measles and pneumonia

were prevalent in January, February and March. A complete system of sewerage is needed.—Dr. F. E. Strout, Sec.

Garfield Plantation.

1894. We have had no infectious diseases. I think our sanitary condition must be about perfect as there has been no sickness.—T. B. Foster, Sec.

Garland.

1894. One case of diphtheria. Two cases of typhoid fever (two houses). One schoolhouse was moved into a location which on account of the dampness, was unhealthful. After agitation of the matter by the board of health, it was moved to higher land in the neighborhood.

1895. Two nuisances were removed. Three cases of diphtheria (one house); two cases of typhoid (two houses). Improved methods of disposing of sewage where there are no sewers, and more care of wells are the greatest needs of this town.—Dr. F. A. C. Emerson, Sec.

Gilead.

1894. We had six cases of typhoid fever. One case of measles and quite a number of cases of German measles.

1895. Five cases of measles in April (two houses).—Seth Bemis, Sec.

Glenburn.

1894. One case of typhoid fever. With this exception, there have been no cases of contagious diseases. There is not a schoolhouse in town properly ventilated.

1895. A general cleaning up of debris and more attention paid to our sources of water supply would have a tendency to improve the sanitary condition of the town, although, generally, it is not very bad now.—John F. Tolman, Sec.

Glenwood Plantation.

1895. No infectious diseases, with the exception of whooping cough in August and September.—W. H. Grant, Sec.

GORHAM.

1894. Two nuisances removed. One case of diphtheria, six of scarlet fever (four houses) and four of typhoid fever (three houses).

1895. One nuisance was removed. Pipe has been laid throughout the village for a water supply and thirty hydrants set. Next spring the citizens will be supplied with Sebago water. One nuisance was removed. Four cases of diphtheria (one house); sixteen of scarlet fever (four houses); two of typhoid (two houses). Houses have been immediately placarded and the families quarantined until the sick have recovered and the premises have been disinfected.—G. W. Heath, Sec.

GOULDSBORO.

1894. One nuisance was removed. No contagious diseases. Five horses have been shot on account of glanders.—B. F. Sumner, Sec.

1895. Four cases of diphtheria (one house). Whooping cough was prevalent.—Dr. C. C. Larrabee, Sec.

GRAFTON.

1895. This seems to be a very healthy locality. There have been no contagious diseases.—Geo. A. Otis, Sec.

GRAND ISLE.

1894. One case of diphtheria.—Clovis Ploude, Sec.

GRAY.

1894. One case of diphtheria; six cases of typhoid fever (three houses). These cases have been looked after as the law directs.

1895. One nuisance was removed. Six cases of diphtheria (four houses).—Geo. W. Osgood, Sec.

GREENBUSH.

1895. No infectious diseases.—H. F. Harris, Sec.

Greene.

1894. Two nuisances were removed. One case each of diphtheria and scarlet fever. The different schools have been vaccinated, and all adults that needed it.

1895. One nuisance removed. One case of diphtheria. Whooping cough was present.—Geo. E. Parker, Sec.

Greenfield.

1895. No contagious diseases reported.—Dr. S. F. Freeman, H. O.

Greenvale Plantation.

There have been no cases of contagious diseases for the two years.—J. L. Collins, Sec.

Greenwood.

1894. One nuisance was removed. Three cases of diphtheria (one house); four of typhoid fever (three houses).

1895. One nuisance removed. We have had no trouble in the abatement of nuisances. We have had no cases of infectious diseases, with the exception of one case of typhoid fever.—A. C. Libby, Sec.

Guilford.

1894. Three nuisances have been removed. Four cases of diphtheria (two houses); one case of typhoid fever. Better drainage is required. One child was burned to death by its clothes taking fire from a stove.

1895. A water supply for eight or ten houses has been put in. Four nuisances removed. One case of typhoid fever.—John Scales, Sec.

Hallowell.

1894. The city has put in sewers in some of the streets, and is doing all it can from year to year. Of thirty or forty nuisances reported to the board, all were removed. Two cases of diphtheria (two houses); eight of scarlet fever (eight houses); eight of typhoid fever (seven houses). When cases of infectious diseases are reported we go directly to the house as soon as the

report is received and give strict directions and cause disinfection to be employed.

1895. A large number of nuisances have been reported to the board, all of which have been removed. Two cases of scarlet fever (two houses); nine cases of typhoid fever (nine houses). An extension of our sewerage system is needed.—Frank Atkins, Sec.

Hamlin Plantation.

1894. We have had no cases of infectious diseases.

1895. We have had no diseases in this town during the year.—John Cyr, Sec.

Hammond Plantation.

1895. No contagious diseases.—T. J. Carpenter, Sec.

Hampden.

1894. Two nuisances were abated. One case of diphtheria; five of scarlet fever (four houses); ten of typhoid fever (ten houses). This case of diphtheria was of a child one year old, whose mother had taken it on a visit to a neighbor in whose house there were two cases of diphtheria in 1889, although the house was thoroughly disinfected in 1889, after those cases of diphtheria.

1895. One nuisance was removed. One case of diphtheria; six of typhoid fever (five houses). Cases of contagious diseases are attended to at once. Quarantine, disinfecting, and cleansing are attended to.

A few instances have come under my observation in which pupils of from eight to ten years of age, have complained of headache which could not be accounted for otherwise than by foul and hot air in the schoolroom as a result of poor ventilation, or not having any ventilation at all in the schoolroom. After looking into the matter and having the schoolroom fairly well ventilated, the children were not troubled with headaches and pallor of the face.

One cow that had been in medium condition began to show suspicious symptoms, and in a few weeks ran down to skin and

bones. The State inspector was called and condemned the animal. A post-mortem examination showed that both lungs were badly diseased and large tubercular masses in connection with the intestinal tract were present.—Dr. W. H. Nason, H. O.

Hancock.

1894. We have had no contagious diseases, but when present we attend to them at once.—Benj. Shute, Sec.

Hanover.

1894. We have had a remarkably healthful year, and no work has been required of our board.

1895. We have again had no work to do, but we have maintained our organization and stand ready to attend to any duty that may arise.—Clark B. Frost, Sec.

Harmony.

1894. Two nuisances were removed. One case of typhoid fever. One family of ten was all down with diarrheal disease and slow fever that was long continued. Upon investigation, we thought the trouble to have been due to polluted water. The sink spout was within one and one-half rods of the well and with a gradual descent down to the well.

1895. One nuisance was removed. Two cases of diphtheria; one of typhoid fever. These cases were isolated, houses were placarded, and we furnished suitable help and otherwise looked after the cases.—L. S. Reed, Sec.

Harpswell.

1895. Two nuisances were removed. One case of scarlet fever and five of typhoid fever (five houses). In the case of scarlet fever there were many children in the immediate vicinity. We gave orders to admit no visitors nor to allow the inmates to leave the house in any way to communicate disease. We saw that the house was fumigated after the recovery of the child. We thus succeeded in limiting the outbreak to this one case.—Aug. Sylvester, Sec.

HARRINGTON.

1894. One case of typhoid fever. 1895. No infectious diseases.—E. R. McKenzie, Sec.

HARRISON.

1894. Our inhabitants were obliged to make such a thorough cleansing of the premises last year, during an outbreak of typhoid fever, that it seems they have not forgotten the lesson, and we have not had a single nuisance to abate nor a case of infectious disease.—Alphonso Moulton, Sec.

HARTLAND.

1895. No infectious diseases.—G. M. Lancey, Sec.

HAYNESVILLE.

1894. There have been no contagious diseases for the year, to my knowledge.

1895. No infectious diseases.—James E. McCready, Sec.

HEBRON.

1894. Two cases of typhoid fever (two houses). Measles and whooping cough in April, May, and June. German measles in May and June.—Dr. J. C. Donham, H. O.

HERMON.

1894. One nuisance abated. One case of typhoid fever.

1895. One nuisance abated. Two cases of diphtheria (one house); one of typhoid fever. Two fatal cases of cerebro-spinal meningitis.—Dr. F. P. Whitaker, Sec.

HERSEY.

1895. We have had no contagious diseases in our town the past year.—L. M. Davis, Sec.

HIGHLAND PLANTATION.

1894. There has been no sickness in the plantation this year, excepting one case of meningitis.—J. R. Ryant, Sec.

1895. We had no contagious diseases.—W. C. Safford, Sec.

Hodgdon.

1894. One case of typhoid fever; all necessary precautions were taken.

1895. Two cases of scarlet fever (one house); two of typhoid fever (two houses). These cases have been promptly attended to.—Moses Benn, Sec.

Holden.

1894. One nuisance was abated. No cases of contagious diseases.—P. L. Pond, Sec.

1895. One nuisance removed. Two cases of typhoid fever (two houses). At the time of the extreme drouth the past season, wells were very low, and some sickness prevailed.—G. C. Wiswell, Sec.

Hollis.

1894. Six cases of scarlet fever (two houses). The houses were disinfected and precautions were taken. One case of tuberculosis in a small herd of cows, native stock.

1895. Two nuisances reported to the board were removed. One case of diphtheria, and two of typhoid fever (one house). The case of diphtheria was in a young man that came home from Boston sick with the disease. We placarded the house, as the law requires, and did what we could to prevent the spread of the disease, and none of the other members of the family were sick. The doctor thought the two cases of typhoid fever came from polluted well water.—S. G. Rumery, Sec.

Hope.

1894. One nuisance was removed. No cases of contagious diseases.—H. H. Payson, Sec.

1895. One case of diphtheria was all the infectious disease we have had.—A. S. Lermond, Sec.

Houlton.

1894. New sewers have been laid, and houses have been connected with the sewers. More than thirty nuisances have been reported to the board, all of which were removed. We had

thirty-one cases of typhoid fever (about fifteen houses). Cleanliness and disinfection were looked out for in connection with these cases. It would be a sanitary improvement if every water-closet and sink spout, so far as possible, were connected with the sewers.

1895. Twenty-six cases cases of scarlet fever, and fourteen of typhoid fever. The schools were closed on account of the presence of scarlet fever and were not again opened until the outbreak had disappeared. A house to house inspection, at three different times, was made in the most populous part of the town. Dr. T. J. Fitzmaurice, H. O.

HOWLAND.

1894. Two nuisances were removed. We have had no contagious diseases. 1895. No contagious diseases.—L. T. Mason, Sec.

HUDSON.

1894. Two cases of scarlet fever (two houses). 1895. We have had no cases of contagious diseases.—A. J. Potter, Sec.

HURRICANE ISLE.

1894. Two nuisances were reported and they were immediately removed. No infectious diseases.

1895. One nuisance removed. We have had no contagious diseases. This place is generally very healthy. Last spring, we had all filthy places upon the island thoroughly cleansed, and everything carted away.—M. H. McIntyre, Sec.

INDUSTRY.

1894. We had twenty-five cases of scarlet fever (eight houses). The houses were immediately isolated and all other necessary precautions were taken.

1895. Three cases of scarlet fever (three houses). Whooping cough was prevalent.—H. B. Luce, Sec.

ISLAND FALLS.

1894. Ten cases of diphtheria (four houses); four cases of typhoid fever. Isolation of the patients, as far as possible, was provided.—Dr. F. F. Bigelow, Sec.

1895. Three nuisances were abated. Twelve cases of diphtheria (five houses); three of scarlet fever (three houses); seven of typhoid fever (two houses). Immediate steps were taken to check the diseases and stamp them out. Whooping cough was prevalent during the summer. A sewerage system is much needed in the village.—S. R. Crabtree, Sec.

ISLE AU HAUT.

1894. Two cases of typhoid fever. Great care was taken with these cases and they did not spread. Our water supply is good and the drainage fair.—Edwin Rich, Sec.

ISLESBORO.

1894. One nuisance removed. Ten cases of scarlet fever (three houses); one of typhoid fever. When the cases have been reported, the houses have been visited, placards posted and the premises examined. Whooping cough was prevalent in the fall.

1895. Three cases of scarlet fever (one house); seven of typhoid fever (three houses). The rules prescribed by the State Board of Health have been carried out in connection with all cases of contagious diseases.—Dr. E. D. Williams, H. O.

JACKMAN PLANTATION.

1894. Four cases of typhoid fever.

1895. Two nuisances were abated. One case of typhoid fever which was promptly investigated and looked after. Whooping cough in November and December.—Dr. T. J. Murphy, H. O.

JACKSON.

1895. No cases of infectious diseases reported.—M. S. Stiles, Sec.

JAY.

1894. Four nuisances abated. Scarlet fever, six cases; typhoid fever, four. Cases of contagious diseases are placarded and put under hospital regulations.

1895. One nuisance was abated. Four cases of scarlet fever (three houses); thirteen of typhoid fever (seven houses). We have made every effort we could to trace sources of infection.—H. H. Allen, Sec.

JEFFERSON.

We have known of no cases of diphtheria, scarlet fever, or typhoid fever either in 1894 or in 1895. Measles was prevalent in 1895.—J. J. Bond, Sec.

JONESBORO.

1894. Diphtheria, one case; scarlet fever, seven (three houses). Houses were placarded and disinfected as the law requires. Two of the cases of scarlet fever were not reported to the board, as the law requires.—L. A. Grant, Sec.

1895. One nuisance abated. Fourteen cases of scarlet fever (five houses). We closed the town hall and all places of amusement, as well as the churches, until we thought it best for all concerned.—J. F. Lord, Sec.

JONESPORT.

1894. One nuisance abated. Two cases of diphtheria (one house); two of scarlet fever (two houses); fifteen of typhoid fever (eight houses). Prompt action was taken. The cases of typhoid fever were in November and December.

1895. Four cases of diphtheria; three of scarlet fever, and two of typhoid fever.—N. Guptill, Sec.

KENDUSKEAG.

1895. One case of diphtheria; two of typhoid fever (two houses). The board attended to its duty in these cases. The sanitary condition of the town is excellent.—Dr. J. F. Benjamin,

KENNEBUNK.

1895. Twelve nuisances were abated. Diphtheria, three cases (three houses); scarlet fever, twelve cases (six houses); typhoid fever, three cases (three houses). The houses were immediately placarded and proper precautions taken. Measles during the summer months. Whooping cough in November and December. Scarlet fever entered our primary schools, on account of which we ordered them closed for a few weeks, which had the desired effect of staying the epidemic. A system of sewerage would be very desirable.—Dr. F. M. Ross, H. O.

KENNEBUNKPORT.

1894. Four nuisances abated. Two cases of typhoid fever (two houses). Two hundred thirty-five persons were vaccinated under the vaccination law. Our town is in a good, healthy condition.

1895. Eight nuisances abated. Five cases of diphtheria, four of scarlet fever, three of typhoid fever. We need a better water supply.—J. J. Goodwin, Sec.

KINGMAN.

1895. We have had no cases of contagious diseases.—Jerome Butterfield, Sec.

KINGSBURY PLANTATION.

1894. We have had no cases of contagious diseases. Two nuisances were abated.—Chas. Strickland, Sec.

1895. The absence of nuisances and of contagious diseases has made it unnecessary to take action. The people in this plantation are in a very healthy condition.—G. G. Robinson, Sec.

KNOX.

1895. One nuisance was abated. A schoolhouse was cleaned and there are three more that are not fit for hogs to stay in, and the voters of those districts will not vote money to repair them. We have had no infectious diseases, with the exception of whooping cough.—J. H. Brown, Sec.

LAGRANGE.

1894. We had one case of typhoid fever. The surface drainage from the school ground, which runs in the direction of the well from which the pupils take their water, should be remedied in the spring.—Dr. A. J. Bradbury, H. O.

1895. We had one case of typhoid fever.

LAKE VIEW PLANTATION.

1894. We have had no cases of diphtheria, scarlet fever, or typhoid fever.

1895. No infectious diseases, with the exception of whooping cough in August and September.—C. F. Bumps, Sec.

LAMOINE.

1894. Two nuisances were removed. Three cases of scarlet fever (three houses). The houses were at once placarded, and circulars from the State Board of Health left at each house, and the strictest watch kept. The general health of the town has been good.

1895. Water has been brought from a spring one-half a mile distant which supplies ten houses or so, where the wells were poor. The health in the town of Lamoine for the past year has been the best for years. Not one case of contagious sickness during the year, and not a nuisance. The board keeps the strictest watch for anything in the shape of sickness or nuisance, and accepts and studies with pleasure all documents received from the State Board of Health.—Nathan D. King, Sec.

LEBANON.

1895. We had four cases of diphtheria (three houses). The houses were closed and all precautions taken.—A. H. Ricker, Sec.

LEE.

1894. An aqueduct has been laid from a high hill into the village, bringing pure spring water into many houses. One nuisance reported to our board, but which we could not remove,

a rum shop. We have had no cases of infectious diseases.—J. M. Daniels, Sec.

1895. No cases of contagious diseases reported. A sewer is needed in the village.—Samuel Bagley, Sec.

Leeds.

1895. I have the pleasure of informing you that no cases of contagious diseases came to the knowledge of the local board of health for the year 1895.—Chas. H. Foster, Sec.

Letter E Plantation.

1894. There have been no cases of contagious diseases reported to our board.—C. H. Crossman, Sec.

Levant.

We have had no cases of diphtheria, scarlet fever, or typhoid fever.—John White, Sec.

Lewiston.

1894. New sewers have been put in which will be of much benefit. There were 400 nuisances reported to the board, 350 of which were removed. Seven cases of diphtheria (seven houses); twelve of scarlet fever (twelve houses). All these places have been quarantined.

1895. About 100 nuisances were reported all of which were removed. We have had six cases of diphtheria (six houses); eight cases of scarlet fever (eight houses); eleven cases of typhoid fever (eight houses.) We have had many water-closets put in the place of old vaults which we believe to be a menace to the health of the city.—Dr. H. H. Purinton, Sec.

Lexington Plantation.

1894. No cases of contagious diseases. 1895. Five cases of scarlet fever (one house).—F. L. Norton, Sec.

Limerick.

1895. One nuisance was removed. We have had neither cases of scarlet fever, diphtheria, nor typhoid fever.—Dr. S. D. Chellis, Sec.

LIMESTONE.

1894. One nuisance was removed. Two cases of typhoid fever (two houses).

1895. Two nuisances removed. Typhoid fever, seven cases (five houses).—Dr. A. D. Hatfield, Sec.

LIMINGTON.

1894. One nuisance was removed. A dead horse was found, last spring, in the mouth of abrook flowing into the Saco River. It was removed by the man who owned the land on which it was found, after due notification to the secretary of this board. Two cases of typhoid fever (two houses). The law has been complied with and enforced in all cases.—L. J. Strout, Sec.

1895. One nuisance was removed. One case of scarlet fever, and one of typhoid fever. These were attended to immediately. The only thing of interest was that there were no secondary cases. The year has been one of unusual health.—L. P. Tompson, Sec.

LINCOLN.

1894. Two nuisances were removed. Four cases of scarlet fever (four houses); one of typhoid fever.—Dr. S. W. Bragg, Sec.

LINCOLN PLANTATION.

1895. No cases of contagious diseases.—N. K. Bennett, Sec.

LINCOLNVILLE.

1895. Five nuisances were removed. Two cases of diphtheria (one house); one case of scarlet fever, and one of typhoid fever. Houses were placarded and isolation seen to.—Dr. E. F. Brown, H. O.

LINNEUS.

1894. We had three cases of typhoid fever (three houses). Measles was present.

1895. One nuisance was abated. Six cases of typhoid fever (four houses). Whooping cough was prevalent, and one school has been stopped on account of it.—Dr. Robert Boyd, H. O.

LISBON.

1894. A sewer has been constructed at Lisbon Falls at rear of the Everett block. Twenty nuisances were reported to the board, eighteen of which were removed. Ten cases of scarlet fever (ten houses); ten cases of typhoid fever. These cases were attended to at once. We have tried to do our duty in all kindness in all cases, without fear and without favor.

1895. Thirteen nuisances were reported, all of which were removed. We have had twenty-five cases of diphtheria (fourteen houses); eighty-five of scarlet fever (forty-eight houses); and eight cases of typhoid fever (four houses). The houses have been placarded and other precautions taken to confine the disease. Measles occurred in November and December, diphtheria in February and March, and scarlet fever in May, June and July.—Alfred E. Jordan, Sec.

LITCHFIELD.

1894. Three nuisances were abated. Three cases of scarlet fever (two houses); twelve cases of typhoid fever (eight houses). We looked after the proper safeguards during and at the close of the disease in each case.

1895. Nine nuisances were abated. Two cases of diphtheria (two houses). It has been an exceptionally healthful year.—G. Roberts, Jr., Sec.

LITTLETON.

1894. We had no cases of contagious diseases.—E. E. Weed, Sec.

1895. Four cases of scarlet fever (three houses); two cases of typhoid fever (two houses). One school was closed three weeks on account of the presence of scarlet fever.—W. P. Curtis, Sec.

LIVERMORE.

1894. One nuisance abated. Five cases of scarlet fever (three houses); three cases of typhoid fever (three houses). But very little work has been required of the board beyond the

proper isolation of contagious diseases. The general health of the community is above the average of like extent.

1895. One case of diphtheria; seven of scarlet fever (five houses). There were about twelve cases of German measles during the year and some confusion has existed in discriminating from scarlet fever. One school was infected by a child taken sick there. The school was stopped and the house was disinfected.—Dr. H. A. Smith, Sec.

Long Island Plantation.

1894. We have had no cases of contagious diseases.—F. E. Gilman, Sec.

1895. Two cases of scarlet fever (one house).—W. S. Rich, Sec.

Lovell.

1894. One nuisance abated. No contagious diseases. 1895. No contagious diseases, excepting whooping cough in August and September.—Dr. C. P. Hubbard, Sec.

Lowell.

1894. No contagious diseases.—Dr. H. S. Brown, Sec.

Ludlow.

1894. One case of typhoid fever. Measles was prevalent, most of the cases being in April.

1895. We had no cases of contagious diseases.—David Small, Sec.

Lyman.

1895. Three nuisances were abated, but we had no cases of contagious diseases.—F. E. Tripp, Sec.

Machias.

1894. Six nuisances were removed. We had ten cases of scarlet fever (ten houses). We have had no cases of diphtheria or typhoid fever. The houses were placarded and the people quarantined, but the man of the house is allowed to follow his usual occupation. The people are not allowed to go out where

they can mingle with others for six weeks, and after thorough disinfection. For the improvement of the village we need the introduction of a good water supply; our water is all taken from wells, nearly every one of which is polluted.—Dr. H. H. Smith, Sec.

MACHIASPORT.

1894. We had five cases of scarlet fever (three houses). Two cases of poisoning resulted from eating canned beef.

1895. One case of typhoid fever. During September and October an epidemic of acute catarrhal dysentery prevailed in this town. The disease was chiefly among children. Seventy-five per cent. of the children under three years of age died. The duration of the disease was from three to ten days. All the adults, excepting the very old, recovered. The only cause that can be assigned was the prolonged dry weather and the infection of old wells.—C. W. Robinson, Sec.
Sec.

MACWAHOC PLANTATION.

1894. There have been no contagious diseases here during the past year. 1895. A few cases of whooping cough last April, but no other contagious diseases.—O. M. Randall, Sec.

MADISON.

1895. A surface drain, some thirty rods in length, has been made through a bog of stagnant water in the rear of Indian Spring Woolen Company's boarding house, on Main street, and has been connected with a natural watercourse that enters Kennebec River. Three nuisances were abated. Three cases of scarlet fever (three houses); one case of typhoid fever. A good system of sewerage is needed in our village.—E. C. Town, Sec.

MADRID.

1894. Six nuisances were abated. No contagious diseases. —F. N. Dunham, Sec.

1895. One nuisance abated. One case of typhoid fever.—Geo. E. Sargent, Sec.

MANCHESTER.

1894. One nuisance abated. One case of scarlet fever, which case was visited by the secretary who found every thing being done to prevent the spread of the disease. The patient remained in a room by herself and was allowed no communication with the other members of the family; a nurse was employed to attend her.

1895. We had no cases of contagious diseases.—G. M. Knowles, Sec.

MAPLETON.

1894. Two nuisances were abated. Two cases of scarlet fever (two houses); four cases of typhoid fever (four houses).

1895. Two nuisances abated. Six cases of typhoid fever (six houses). Disinfectants were used to prevent the spread of the disease.—L. W. Hughes, Sec.

MARIAVILLE.

1894. Two cases of typhoid fever (two houses). The advice of the physicians in attendance was followed strictly in and around the infected houses. One of these cases of typhoid fever was contracted away from here.—W. H. DeLaittre, Sec.

1895. Two drains have been laid. The town has been quite free from sickness.—Wm. Carr, Sec.

MARION.

1895. We have had no contagious diseases. Nothing to make business of any kind for the board.—B. L. Smith, Sec.

MARSHFIELD.

1894. Two cases of scarlet fever (two houses). These cases were among pupils of the school. The rest of the children belonging to that family were excluded from the school.

1895. One nuisance abated. Eleven cases of typhoid fever (three houses).—L. B. Thaxter, Sec.

Mars Hill.

1894. No cases of infectious diseases came to our notice.

1895. We had ten cases of typhoid fever (ten houses). I have looked after these cases closely.—B. F. Pierce, Sec.

Masardis.

1984. No cases of infectious diseases reported.

1895. One case of typhoid fever. The premises were guarded and a thorough disinfection was looked after.—F. W. E. Goss, Sec.

Mason.

1894. No infectious diseases, except whooping cough in January and February; and the German measles in April and May. One case of measles was found in one of the schools: the school was closed a few weeks and the children from the infected house were quarantined.

1895. One nuisance removed. No infectious diseases . As a whole, we are a very healthy community.—A. S. Bean, Sec.

Matinicus Isle Plantation.

1894. No infectious diseases, except mumps in April, May and June.—E. E. Ames, Sec.

1895. No infectious diseases—E. A. Young, Sec.

Mattamiscontis.

We have had no cases of infectious diseases in the town during the two years, with the exception of three cases of whooping cough. We have a plenty of good, pure air and water, which I think are most needed for our health. We had one case said to have been of lead poisoning, which was not fatal.—H. C. Roberts, Sec.

Mattawamkeag.

1895. Two cases of scarlet fever (two houses). The houses were placarded, and the neighbors were forbidden to go to the house. On account of scarlet fever, the schools were closed and the school rooms were fumigated.—F. A. Greenwood, Sec.

Maxfield.

1894. One nuisance removed. One case of typhoid fever. Measles in June.

1895. One nuisance removed. One case of typhoid fever. Our town is small and, as a general thing, we are healthy. —James Wiley, Sec.

Mayfield Plantation.

1894. We had twelve cases of typhoid fever (two houses). A nurse was provided and the houses were disinfected.—A. B. Clark, Chr.

1895. One case of typhoid fever.—C. V. Brown, Sec.

Mechanic Falls.

1894. Ten nuisances were removed. No cases of diphtheria, but we had eight of scarlet fever (four houses); and ten of typhoid fever (seven houses). Infectious cases were isolated and properly taken care of.— Dr. C. M. Cobb, Sec.

1895. Water works have been put into town, the supply being taken from driven wells. Eight nuisances reported to the board were all removed. Six cases of scarlet fever (five houses); two of typhoid fever (two houses). The board has complied with the requirements of the law in each case.—M. N. Royal, Sec.

Meddybemps.

No infectious diseases either in 1894 or 1895.—A. J. Allen, Sec.

Medford.

1894. One case of diphtheria: the usual precautionary measures were carried out. No other contagious disease.

1895. One case of diphtheria; six or eight of scarlet fever (three houses). The houses were placarded and all possible measures taken. A few cases of whooping cough.—S. O. Dinsmore, Sec.

Medway.

1895. Two nuisances removed. No infectious diseases save whooping cough.—A. Hathaway, Sec.

Mercer.

Neither in 1894 nor in 1895 were there any cases of contagious diseases.—C. H. Girdler, Sec.

Merrill Plantation.

1894. No infectious diseases. 1895. One nuisance removed. —Mrs. J. H. Gardner, Sec.

Mexico.

1894. Three nuisances have been removed. At Mexico Corner there is a small brook which is sometimes full of water, and at other times it is dry. On its banks are situated six dwellings. The sink wastes, and privies, and two stables contaminate this brook. We recommended that the town put in a sewer to take the place of the brook, but it has not been done. Three cases of typhoid fever. We investigated the surroundings of two of these cases. The other occurred in a new dwelling where the surroundings were such that we deemed it unnecessary to do so. Two of the cases of typhoid fever were on the borders of the stream previously referred to. We also investigated a reported case of scarlet fever, but found no case. Cases of whooping cough occurred in the early part of the year.

1895. One nuisance was removed. One case of typhoid fever. There were some cases of influenza among horses, and some men thought they caught the disease from the horses.—Dr. H. J. Binford, Sec.

Milbridge.

1894. Three nuisances were abated. We had twenty-four cases of scarlet fever (twelve houses), and one case of typhoid fever.

1895. Eighteen cases of scarlet fever; two of typhoid fever. Whooping cough in the latter part of the year. One fatal accident occurred from a folding bed.—Dr. Geo. Googins, Sec.

Milford.

1894. Two nuisances removed. No infectious diseases.

1895. Three nuisances removed. Sink drainage causes more trouble than anything else. One case of typhoid fever.—M. W. Sawyer, Sec.

Milo.

1895. No cases of contagious diseases, excepting whooping cough.—F. E. Monroe, Sec.

Minot.

1894. We have had no contagious diseases. The town was vaccinated in March.

1895. One nuisance was removed. Three cases of typhoid fever.—N. P. Downing, Sec.

Monhegan Plantation.

1894. No contagious diseases this year.—Geo. E. Smith, Sec.

1895. No contagious diseases.—Sanford W. Sterling, Sec.

Monmouth.

1894. Three nuisances were removed. One case of scarlet fever, six of typhoid fever (two houses). Quarantine and disinfection were carried out.

1895. Three nuisances were removed. The mill streams have been cleared, and notices have been posted forbidding refuse matter being thrown into them. Two cases of diphtheria (two houses); three of typhoid fever (three houses). Proper precautions have been taken.—Dr. E. P. Marston, Sec.

Monroe.

1894. We had five cases of typhoid fever (two houses).—Dr. C. C. Whitcomb, Sec.

Monson.

1894. We have had no contagious diseases. Better sewerage is needed.

1895. Three cases of typhoid fever (three houses).—D. J. Jackson, Sec.

MONTICELLO.

1894. Ten cases of scarlet fever (eight houses); one of typhoid fever. Infected dwellings were placarded and flagged, and the inhabitants were instructed as to disinfecting the premises, excluding visitors, care about going among neighbors, disinfecting clothing, etc.

1895. Thirteen cases of scarlet fever (nine houses). Two of the schools were closed for two weeks on account of the danger from scarlet fever.—L. E. Stackpole, Sec.

MONTVILLE.

1895. Two nuisances removed. Two cases of diphtheria (one house). The cases were quarantined.—A. D. Ramsey, Sec.

MORO PLANTATION.

1894. We have had no cases of contagious diseases, excepting eight cases of measles in May.—Daniel Darling, Sec.

1895. We had two cases of typhoid fever.—Patrick Darling, Chr.

MORRILL.

1894. No contagious diseases. 1895. Four cases of scarlet fever (one house). Whooping cough was prevalent.—Dr. T. N. Pearson, Sec.

MOSCOW.

1894. There have been no contagious diseases in town the past year.

1895. We had one case of diphtheria which was reported promptly, and looked after by the board. Several cases of whooping cough. It would improve the health conditions of our town if, when the citizens are locating their wells, they would endeavor by all means to have them above their buildings and where they cannot be polluted.—A. Burke, Sec.

MOUNT CHASE.

1895. No contagious disease, but whooping cough in the spring. The schools were not closed, but we did not allow

children who had the disease to attend, and it did not enter the schools.—E. A. Cooper, Sec.

MOUNT DESERT.

1894. Three cases of scarlet fever (two houses). Mumps was present.

1895. One case of scarlet fever. This case was investigated and treated according to the requirements of the law. Whooping cough at Somesville during the winter months. As a whole the town has been in a very healthy condition.—Geo. E. Ring, Sec.

MOUNT VERNON.

1894. We have had no contagious diseases. One infant was asphyxiated by being wrapped too closely while its parents were traveling.

1895. No cases of contagious diseases.—Dr. H. F. Shaw, Sec.

NAPLES.

1894. Three nuisances were removed. The condition of the town has been very healthful, with no contagious diseases.

1895. Two nuisances were removed. One case of typhoid

1895. Two nuisances were removed. Whooping cough was prevalent. One case of typhoid fever. The case of typhoid fever was caused by polluted water.—Phillip O. Cannell, Sec.

NASHVILLE PLANTATION.

1895. No contagious disease.—Andrew Henry, Town Clerk.

NEWCASTLE.

1894. Two cases of typhoid fever.

1895. Two nuisances removed. No contagious diseases. We have been blessed with an unusual exemption from contagious diseases.—D. S. Glidden, Sec.

NEW GLOUCESTER.

1894. Two nuisances were removed. No contagious diseases reported.

1895. One sewer was built. Two nuisances removed. Three cases of typhoid fever (three houses).—G. Z. Benson, Sec.

NEW LIMERICK.

1895. Three cases of typhoid fever (three houses).—Manthano Lougee, Sec.

NEWPORT.

1894. We have a fine water system, introduced last fall. Pure water from the lake three miles away. About sixty families have it in their homes, and the use will become general another season. Sewerage will be put in next year. One nuisance was removed. Three cases of typhoid fever (three houses). Instructions were given to the families and we are well assured that they have been carried out.

1895. Two nuisances were removed. One case of diphtheria; the family quarantined, house placarded, and thorough disinfection after the recovery of the patient. One case of typhoid fever. All sanitary conditions followed out. The case was contracted away from home.—F. M. Shaw, Sec.

NEW PORTLAND.

1894. Four nuisances abated. One case of scarlet fever; three of typhoid (three houses). We are doing what we can to bring the people to see and understand the necessity of a proper care of vaults and sink drainage which is the great nuisance in the country towns.

1895. Two nuisances removed. Thirty cases of scarlet fever (ten houses); two of typhoid fever (two houses). We have done all in our power to prevent the spread of these diseases, by isolation, disinfection, removing all known causes of contagion, etc.

A bridge within the North village, fourteen feet from the stones below, had been without a railing since the great fire of 1891. The local board of health regarding it their duty to attend to the matter and to make the bridge safe, on petition to the citizens, claimed it to be a nuisance dangerous to life and health. After conferring with the secretary of the State Board as to their duty, the municipal officers of the town were informed

as to the status of the matter and they directed the secretary of the local board to construct such a protection as he deemed necessary. It was done to the satisfaction of all parties.—Dr. W. H. Stevens, H. O.

New Sharon.

1894. No contagious diseases reported.

1895. We had ten cases of diphtheria (one house). The teacher of the district was immediately notified to exclude scholars from the infected house. Whooping cough and measles have existed to some extent.—D. R. Hargraves, Sec.

New Sweden Plantation.

1894. We had no contagious diseases.—N. E. Ringdahl, Sec.

New Vineyard.

1894. One case of diphtheria; six of scarlet fever (two houses). Prompt action has been taken.

1895. One nuisance removed. Nine cases of scarlet fever (four houses). Infected houses immediately placarded and all other precautionary measures taken. Whooping cough in December.—W. A. Lee, Sec.

Nobleboro.

1894. Three cases of typhoid fever (three houses). They were looked after according to instructions from the State Board.

1895. Three cases of typhoid fever (three houses); one case of measles.—J. M. Winslow, Sec.

Norridgewock.

1894. One nuisance removed. No infectious diseases, with the exception of chicken-pox and whooping cough.

1895. One nuisance removed. One case of measles, but none of diphtheria, scarlet fever, or typhoid fever. It has been a very healthy year in our town.—F. C. Holt, Sec.

North Berwick.

1895. Two nuisances were reported and removed. Twenty-nine cases of scarlet fever (twenty-nine houses); two cases of typhoid fever (two houses). In the unusual number of cases of scarlet fever, cases occurred far removed from each other and in children who had been wholly isolated for months. How the infection was brought was unaccountable, so the physician said. Better drainage is needed in some of the localities in the village. —H. A. Butler, Sec.

By-Laws of the Board of Health of the town of North Berwick, Me. Adopted May 15, 1893.

1. A public funeral shall not be held for any person who has died of scarlet fever, diphtheria, small-pox, cholera or typhus fever; and the body of any person who has died of any of these diseases shall neither be brought within nor carried without the jurisdiction of this board without permission in writing from the board, nor shall there be a disinterment of any body after it has once been buried, without the written permission of the board.

2. No dead animal shall, within the jurisdiction of this board, be put into any river, well, spring, cistern, reservoir, stream or pond, nor allowed to remain on the surface to become offensive to the neighborhood.

3. The collection of refuse matter in or around the immediate vicinity of any dwelling-house or place of business, such as sink drainage, swill, waste of meat, fish or shells, bones, decaying vegetables, dead carcasses, excrement, or any kind of offal that may decompose and generate disease germs or unhealthy gases, and thus affect the purity of the air, shall be considered the worst kind of nuisance and must be removed or disposed of either by burial, burning or otherwise, and in such manner that it may not be offensive to the neighborhood wherever located.

4. No privy vault, cesspool or reservoir, into which a privy, water-closet, stable, or sink is drained, except it is water-tight, shall be established or permitted within one hundred feet of any

well, spring, or other source of water used for drinking or culinary purposes.

5. All privy vaults, cesspools, or reservoirs named shall be cleaned out twice a year, once in the spring, not later than the 15th of May, and once in the autumn, not earlier than the 15th of October.

6. Earth privies and earth closets, with no vault below the surface of the ground, shall be excepted in six; but sufficient dry earth or coal ashes must be used daily to absorb the fluid part of the deposit, and the entire contents must be removed at least monthly.

7. All sewer drains that pass within fifty feet of any source of water used for drinking or culinary purposes shall be watertight and in sandy soil the limit shall be eighty feet.

8. Swine shall be kept in such place and manner as not to be offensive to the persons residing in the vicinity; and their pens and yards must be kept deodorized by the application of dried muck, dry earth, or some other effective absorbent. The same rule, with regard to deodorization, applies to horses, cows and other stock.

Chapter 123, Public Laws of 1887.

Section 26. Any person who shall wilfully violate any of the provisions of this act or of said regulations and by-laws the penalty for which is not herein specifically provided for, and any person who shall wilfully interfere with any person or thing to prevent the execution of the provisions of this act or of said regulations and by-laws, shall be guilty of a misdemeanor and upon conviction thereof shall be subject to a fine not more than fifty dollars.

The householders of North Berwick, and especially those residing in the village of Doughty's Falls, will admit the necessity of observing sanitary regulations, and that no one should neglect measures necessary to guard against the introduction of contagious and infectious diseases, by removing from their premises all matter liable to communicate contagion.

The local board of health deem it a necessity to announce that the rules contained in the by-laws herein set forth, now in force, must be practically observed, and Wm. A. Morrill will be made the agent of the board of health, to whom application can be made for any service relating to the suppression and removal of nuisances and conditions detrimental to life and health, found to exist on any premises within the limits of our jurisdiction.

NORTHFIELD.

1895. One case of measles, which was immediately isolated and prevented from spreading.—C. B. Albee, Sec.

NORTH HAVEN.

1894. One nuisance was removed. No contagious diseases reported.

1895. Four nuisances removed. We have had no cases of contagious diseases.—R. B. Quin, Sec.

NORTHPORT.

1894. Two cases of typhoid fever (two houses). These cases were imported. Ours is a very cleanly and healthy town.

1895. One nuisance removed. One case of scarlet fever. One non-fatal case, said to be typhoid fever, was not reported by the attending physician.—F. A. Rhodes, Sec.

NORTH YARMOUTH.

1894. One nuisance removed. One case of scarlet fever, and one of typhoid. The requirements of the law have been fulfilled.

1895. One nuisance removed. One case of scarlet fever; two cases of whooping cough.—E. D. Loring, Sec.

NORWAY.

1894. Two cases of scarlet fever (two houses); six of typhoid fever (four houses). Action was taken in accordance with the requirements of the law and the instructions of the State Board.

1895. Two cases of scarlet fever (two houses). No other infectious disease with the exception of whooping cough in November and December. The sanitary condition of the town would be improved by a system of sewerage.—Dr. F. N. Barker, Sec.

No. 1, R. 2, W. K. R. Plantation.

1894. We had one case of typhoid fever.—Daniel Robinson, Chr.

No. 21 Plantation.

No cases of contagious disease either in 1894 or in the past year.—C. H. Yates, Sec.

No. 33 Plantation.

1894. One case of typhoid fever in a mild form. 1895. No contagious diseases.—J. R. Shuman, Sec.

Oakland.

1895. Four nuisances were removed. Six cases of diphtheria; two of typhoid fever. These cases were all carefully attended to.—H. W. Wells, Sec.

Old Orchard.

1894. A new outlet to the sea has been built for the sewerage system at the upper end of the village. Eight nuisances were removed. We had one case of typhoid fever.—A. M. Chase, Sec.

1895. Of fifty-eight nuisances reported to the board, forty-seven were removed. There are some nuisances yet remaining, to the owners of which orders have been given to remove them in the spring. Four cases of scarlet fever, and six of typhoid fever. We have endeavored to improve the sanitary condition of the village in every respect.—R. F. Chalk, Sec.

Old Town.

1894. Of fifteen nuisances reported to the board, ten were removed. Four hundred forty-seven children were vaccinated. —Dr. G. G. Weld, H. O.

1895. About one mile of sewers has been laid, 1,200 feet of water supply pipe and 1,200 feet of surface drainage. Eight nuisances were removed. Twelve cases of typhoid fever.—H. M. Dickey, Sec.

ORIENT.

1894. We have had no cases of diphtheria, scarlet fever or typhoid fever. It has been very healthy the past year.

1895. No cases of contagious diseases.—Daniel Maxell, Sec.

ORLAND.

1894. One case of diphtheria; two of scarlet fever (two houses).—R. P. Harriman, sec.

1895. No cases of contagious diseases.—Frank Buck, Sec.

ORNEVILLE.

1894. No cases of infectious diseases.—Fred Hoxie, Sec.

1895. No contagious diseases reported.—V. Fabian, Sec.

ORONO.

1894. Seven nuisances were removed. We had one mild case of diphtheria, and eleven of typhoid fever (four houses).

1895. Two nuisances were abated. Four cases of diphtheria (two houses); one case of scarlet fever; and two of typhoid fever (two houses).—W. C. Taylor, Sec.

OTIS.

1894. No contagious diseases.—J. R. Grant, Sec.

1895. No contagious diseases, with the exception of whooping cough.—A. S. Young, Sec.

OTISFIELD.

1894. No contagious diseases, except German measles in April and May.

1895. Two cases of typhoid fever (two houses). Whooping cough in May and June.—E. B. Jillson, Sec.

OXFORD.

1895. Three cases of typhoid fever.—Dr. A. L. Hersey, H. O.

PALERMO.

1895. Eighteen cases of diphtheria (six houses); one of scarlet fever. Whooping cough in October and November. Diphtheria extended six miles across our town from a mild case, and our board had an opportunity to put a strict quarantine into effect, but when our patient died there was no further spread of diphtheria. The spirit as well as the letter of the law was then observed. We stopped all our schools and saw that no one was exposed but the nurses, and that was the last of the outbreak.

A lady with a child two and one-half years old, visited her parents. A member of the family was then sick with tonsillitis, as they supposed. The patient kissed the child; in three days the child had diphtheria.—Dr. M. Delany, Sec.

PALMYRA.

1894. One nuisance removed. Five cases of diphtheria (two houses); five cases of scarlet fever (one house); one case of typhoid fever. The schools were stopped and all infected families were quarantined. Measles prevailed in one school district.

1895. Two mild cases of typhoid fever. We looked after the cases in accordance with the requirements of the law. Our town has been in a very healthy state most of the time for a good many years.—G. W. Hanson, Sec.

PARIS.

1894. Sixteen nuisances reported to the board were all removed. It is a difficult matter to manage sink spout nuisances in villages where there are no sewers. Two cases of typhoid fever (two houses). The health officer has at once attended to his duties as the law requires in such cases.—Dr. F. H. Packard, Sec.

1895. Five nuisances removed. Fifteen cases of diphtheria (six houses); one case of typhoid fever. In these cases the board visited the houses, placarded them, quarantined the family until the case had convalesced, and then attended to the disinfection.—Dr. Horatio Woodbury, Sec.

Parkman.

1895. Two nuisances were removed; one, a slaughter-house, gave some difficulty in the abatement.—N. M. Cobb, Sec.

Parsonsfield.

1894. Seven cases of scarlet fever (four houses).—Geo. E. Perkins, Sec.

1895. We had no cases of contagious diseases. The year has been one of especial health.—Dr. J. W. Dearborn, Sec.

Passadumkeag.

We have had no infectious diseases either in 1894 or in 1895. —Dr. E. H. Stanhope, H. O.

Patten.

1894. There has been an improvement in the water supply in our village. No contagious diseases. Better sewerage is needed. Two cases of poisoning by a cancer cure quack occurred, one of which had fatal results.

1895. Two nuisances removed. Three cases of diphtheria (one house); three of typhoid fever (three houses). The proper precautions were employed in connection with these cases. Whooping cough in the latter half of the year.—Dr. W. T. Merrill, Sec.

Pembroke.

1894. One case of typhoid fever.—Wm. Welch, Sec.

1895. Five cases of scarlet fever (five houses). The inmates of the infected houses have been restricted as required by law.—Dr. J. C. Rogers, Sec.

Penobscot.

1894. One sewer, about twenty-five rods in length, has been constructed where it was very much needed. In the most

thickly settled part of the town a greater part of the water supply is now rain water filtered through soft brick. Formerly the supply was almost wholly from wells, the water from which was more or less brackish. Since the change, typhoid fever and kindred diseases have been much less frequent. One case of scarlet fever, and three of typhoid (two houses).

From January to June a disease prevailed among swine to an unusual extent; nearly all taking the disease died.

1895. One nuisance was removed. One case of diphtheria, one of scarlet fever, and two of typhoid fever. Our board has taken each case in hand promptly and treated it as the law directs. Our people are looking more carefully than formerly after the sanitary condition of the surroundings, in all particulars.—J. H. Littlefield, Sec.

PERHAM PLANTATION.

1894. One case of typhoid fever. Measles in the summer.

1895. Four cases of typhoid fever; three of whooping cough. —C. I. Spaulding, Sec.

PERKINS.

1895. No cases of contagious diseases.—C. W. White, Sec.

PERRY.

1894. No cases of diphtheria, scarlet fever, or typhoid fever the past year.—Geo. W. Clark, Sec.

PERU.

1894. One case of diphtheria; nine of typhoid fever (five houses). When infectious diseases occur, at least two members visit the premises to learn the probable cause of the outbreak, furnish circulars of instructions, give whatever assistance and advice are needed, and see that needful cleansing and disinfection are done.—Mandeville Hall, Sec.

1895. Two cases of typhoid fever (two houses). We have attended to these cases as the law directs.—O. O. Tracy, Sec.

PHILLIPS.

1894. One case of diphtheritic croup; one of scarlet fever; three of typhoid fever (three houses).—B. E. Pratt, Sec.

PHIPPSBURG.

1894. Four cases of typhoid fever (two houses). 1895. Three cases of scarlet fever (three houses).—Dr. M. H. Ferguson, Sec.

PITTSFIELD.

1894. Sewers have been extended, and the village now has a fine system of water works. Four nuisances were removed. Typhoid fever, seven cases (seven houses).

1895. Five nuisances removed. Two cases of diphtheria (two houses); fourteen of typhoid fever (twelve houses). Every possible precaution is taken in connection with these cases.—Dr. T. M. Griffin, H. O.

PITTSTON.

1894. Whooping cough in August; measles in September and October, and mumps in December. No cases of diphtheria, scarlet fever or typhoid.—F. H. Mooers, Sec.

PLYMOUTH.

1894. One nuisance removed. Four cases of typhoid fever (four houses).—Dr. A. W. Sylvester, Sec.

1895. Three cases of scarlet fever (one house); three of typhoid fever (two houses).—Arthur Macomber, Sec.

POLAND.

1894. Four cases of scarlet fever (three houses); five of typhoid fever (three houses). The secretary has visited the infected houses as soon as possible and taken proper action at once. Measles was unusually prevalent in June and July, but the disease was generally mild, with the exception of a few cases in adults.

1895. Two nuisances were removed. One case of typhoid fever; several cases of German measles in the winter and spring,

one of which was fatal. The rash was said to have returned the third time in this case. For the improvement of the sanitary condition of the town there are needed more cleanly kept privies, and water for drinking and domestic purposes from wells not polluted by privies, pig-pens, and sink drains.—Dr. Jason Walker, Sec.

Porter.

1894. Three nuisances were removed. For infectious diseases we have had only one case of diphtheria, and whooping cough in December.

1895. One case of diphtheria. This case appeared to have been due to water from a well which was polluted by the bursting of a sink drain and leaking of the sewage into the well.—Dr. E. R. Chellis, H. O.

Portland.

1894. We had during the year 52 cases of diphtheria, 151 of scarlet fever and 144 of typhoid fever. Houses have been quarantined as soon as reported. Three schools were fumigated on account of a few scholars having contagious diseases.

1895. Fifty meetings were held by our board during the year. There came under the observation of the board 662 nuisances, 594 of which were removed.

Diphtheria, 127 cases (80 houses), scarlet fever, 65 (48 houses), typhoid fever, 107 (83 houses).

When infectious diseases have been introduced into the schools, the schools have been closed, and the schoolrooms have been washed in the solution of bichloride of mercury, and fumigated.—Edwin L. Dyer, Sec.

Pownal.

1894. Two cases of diphtheria (one house); two of typhoid fever (two houses). In all these cases we have tried to carry out the instructions of the State Board of Health.

1895. One case of typhold fever, and a few cases of whooping cough.—Dr. S. A. Vosmus, Sec.

Prentiss.

1895. No cases of contagious diseases this year or last.—T. N. Butterfield. Sec.

Presque Isle.

1895. Two nuisances abated. We have had more difficulty in managing piggeries than with all other nuisances combined. Hog cholera made its apperance in two herds, destroying about seventy-five animals. Twenty-five cases of scarlet fever (eight houses); thirty-three cases of typhoid fever (thirty houses). Isolation, placarding and disinfection were carried out. Whooping cough was very prevalent during the summer. The sanitary condition of our town would be improved by the abolition of cesspools and privy vaults, and a greater care on the part of householders in the disposal of rubbish and decaying vegetable matter.—Dr. Frank Kilburn, Sec.

Princeton.

1894. One case of scarlet fever, and one of typhoid fever. We always use every precaution in connection with these cases. It has been a year of unusual good health. We had the town vaccinated in the month of April, which was a success.

1895. We had three mild cases of scarlet fever, and there was some prevalence of whooping cough.—Dr. S. G. Spooner, Sec.

Randolph.

1894. Five nuisances were abated. One case each of scarlet fever and typhoid fever. Measles had quite a run in the spring.

1895. Two nuisances were abated. Several complaints have been made, but on investigation they have been found trivial. One case of scarlet fever; mumps and whooping cough were prevalent. Sewers are very much needed for the improvement of the health condition of the town.—B. A. Cox, Sec.

Rangeley.

1894. Four nuisances were abated. Two cases of scarlet fever (two houses), and one case of typhoid fever.

1895. Two nuisances were abated. We had nine cases of scarlet fever (four houses).—L. J. Kempton, Sec.

RANGELEY PLANTATION.

1894. We had no contagious diseases.—E. M. Gile, Sec.

RAYMOND.

1894. We had three cases of scarlet fever (one house), and eight cases of typhoid fever (three houses). Measles occurred in October and November, and three deaths occurred from this disease.

1895. One case of scarlet fever, and two of typhoid fever (one house). These cases have been attended to at once. Whooping cough was prevalent. A better management of sink drainage would improve the sanitary condition of the town, and so would, in many cases, the removal of the privy to a greater distance from the buildings.—Hiram M. Cash, Sec.

READFIELD.

1894. One nuisance was removed. Three cases of typhoid fever.

1895. Some improvements have been made in the water supply of the village. We had one case of diphtheria, but none of scarlet fever or typhoid fever.— Dr. W. A. Wright, Sec.

RICHMOND.

1894. Three nuisances were abated. We had three cases of diphtheria (three houses), and ten cases of typhoid fever (seven houses). In cases of infectious disease the houses are always placarded, and special instructions given relative to the sanitary rules pertaining to each case. In one case a constable was employed to insure the prevention of the spread of the disease.

1895. A decided improvement has been made in regard to the efficiency of drainage through the work done by the selectmen in putting in drain pipes of large size. Four nuisances were removed. In each case, the persons responsible for the nuisance have been found ready and willing to remove it.

We have had eight cases of diphtheria (two houses), and one case of typhoid fever.

It is gratifying to state that the selectmen have shown their appreciation of the work of the board by appealing to them or requesting them to see that certain nuisances were removed at once, and in having a commendable pride in the matter of improving the sanitary condition of the town. The benefit of local sanitary measures is well illustrated in the work of our board in connection with cases of diphtheria. The attending physician was of the opinion that the germs of the disease had existed in the house for ten or twelve years, for so long ago as that diphtheria existed in the house in a severe form. The carpets of the present occupant, which were taken up and beaten by the young man who first contracted the disease, possibly received germs which had existed in the cracks of the floors.—Dr. D. S. Richards, Sec.

Ripley.

1894. Two nuisances were removed. Two cases of typhoid fever (two houses). The usual precautions were observed.

1895. Two nuisances were removed. In every case there has been pleasant and speedy co-operation on the part of all concerned. One case of typhoid fever, and seven cases of mumps. Two cases of fatal disease in horses occurred on the same day and in the same neighborhood. Both died in from eight to ten hours. The most marked symptoms were wheezing and belching wind.—A. G. Farrar, Sec.

Robbinston.

1894. No cases of infectious diseases reported. Our schoolhouses and grounds are in a good condition.

1895. No cases of infectious diseases.—Frank R. Leach, Sec.

Rockport.

1895. Two nuisances removed. Seven cases of diphtheria (five houses), and seven cases of scarlet fever (seven houses). We need better sewerage, but a difficulty exists on account of ledge.—Dr. S. Y. Weidman, Sec.

ROME.

1894. No cases of contagious disease.

1895. One nuisance was removed. Four cases of diphtheria (two houses). We think the cases of diphtheria were brought to our town by a child who was said to be sick with membranous croup. The child died and other children in the same house were soon after taken sick with diphtheria.—L. G. Martin, Sec.

ROQUE BLUFFS.

1894. We have had five cases of scarlet fever (two houses).

1895. No cases of infectious diseases, with the exception of whooping cough in November and December.—A. L. Tupper, Sec.

ROXBURY.

1894. We have had no contagious diseases the past year.

1895. There has been an entire absence of contagious diseases.—A. W. Robbins, Sec.

SACO.

1894. The drainage has been improved by the extension of several sewers. Forty nuisances were reported to the board, of which thirty-eight were removed. In one case the city refused to furnish a sewer for the drainage of a stable. After an order from the local board of health to complete the sewer, the city voted to complete it and did so. Eight cases of scarlet fever (five houses), and four of typhoid fever (four houses). Whooping cough was present in May and June. One building, temporarily used for school purposes, was decidedly unhealthful and over crowded. The board notified the supervisor of the schools that the school should not be allowed to continue in that building. The school was, therefore, closed. Proper filtering of the city water supply and a more efficient protection of its source from dead animals would probably improve the sanitary condition of the town.—Dr. C. W. Pillsbury, Sec.

1895. About 1,400 feet of sewers have been built, but more are needed. Forty-five nuisances have come to the attention of the board, all of which were removed. One case of diph-

theria; nineteen of scarlet fever (nineteen houses), and forty of typhoid fever. In connection with cases of infectious diseases the premises are visited and all infected houses quarantined until disinfected.—Dr. J. D. Haley, Sec.

SALEM.

No cases of contagious diseases, with the exception of one case of measles in 1894.—Geo. E. Willis, Sec.

SANFORD.

1894. We had thirty-two cases of diphtheria (sixteen houses); twenty-one of scarlet fever (thirteen houses), and ten of typhoid fever (five houses). The unusual prevalence of diphtheria in our town during the fall was of a malignant type, and the death-rate large. We have investigated the matter thoroughly to find the cause for it, but without success.

1895. Several sewers have been put in, discharging into the river. Three nuisances were removed. One case of membranous croup; eleven of diphtheria (eight houses); ten of scarlet fever (nine houses), and four of typhoid fever (four houses). —Geo. E. Allen, Sec.

SANGERVILLE.

1895. Improvements have been made in several localities where the drainage was bad. Four nuisances have been removed. Two cases of scarlet fever (two houses); one case of typhoid fever.

By enforcing our sanitary laws and rules the communication of scarlet fever was prevented in the above cases.—Dr. C. W. Ray, H. O.

SCARBORO.

1894. Of two nuisances reported, the board succeeded in abating one. Five cases of typhoid fever. German measles during March and April.

1895. One nuisance was abated. Two cases of typhoid fever (two houses). Chicken-pox entered one of the schools.—Dr. H. H. Allen, H. O.

Searsmont.

1894. No infectious diseases. 1895. Two cases of diphtheria (two houses).—L. C. Poor, Sec.

Searsport.

1894. Two nuisances were abated. Twenty-one cases of scarlet fever (twelve houses); one case of typhoid fever. Whooping cough from July to September. All the cases of scarlet fever have been extremely light.

1895. Four nuisances were abated. Ten cases of scarlet fever (seven houses); two of typhoid fever (two houses). It was not necessary to close the schools on account of scarlet fever. We isolated the cases and quarantined the families.—Dr. E. H. Durgin, H. O.

Sebago.

1894. Two cases of scarlet fever (two houses). The houses were placarded at once, and in due time disinfection was carried out.

1895. One case of scarlet fever.—Abram J. Ward, Sec.

Sebec.

1894. No infectious diseases.

1895. Measles and whooping cough were present from May to October, but we had no cases of diphtheria, scarlet fever or typhoid fever.—Clarence Parker, Sec.

Seboeis Plantation.

1894. No infectious diseases.—O. L. Dugans, Sec.

1895. We have had no contagious diseases.—E. L. Smart, Sec.

Sedgwick.

1894. One nuisance was abated. One case of typhoid fever. The absence of contagious diseases would indicate that the sanitary conditions of our town must be quite good.

1895. Among the farming community quite an extensive improvement is noticeable in the sanitary conditions. Two

nuisances were removed. Three cases of typhoid fever (three houses). The influence of the local board of health is a great improvement in keeping some persons from overlooking a nuisance, as they know it will be reported.—M. L. Elwell, Sec.

Shapleigh.

1894. One nuisance was removed. One case of scarlet fever, which was attended promptly. Among domestic animals there was one case of tuberculosis, attended by Dr. Bailey. There were a number of cases of hog cholera, and a case of measles in a hog which was killed.

1895. We have had no cases of contagious diseases during the year.—Dr. W. W. Smith, Sec.

Sherman.

1894. One nuisance was removed. One case of diphtheria; four of typhoid fever (one house). Immediate action has been taken; the cases investigated, and prompt measures have been taken to stamp out the outbreak. More thorough drainage of private premises, and greater care in securing pure water and better ventilation of public and private buildings would improve the sanitary condition of the town.

It has been the rule of our board to visit the school premises once a year, as well as all public buildings whether there is complaint or not. The object in view has been a thorough cleansing of water-closets and school buildings and school yards, and the securing of a pure public water supply. Our recommendations have generally been respected.

It is a fact that the citizens generally endorse and sustain the action of the board of health in taking prompt measures to stamp out contagious diseases, and in the securing of cleanliness in all public and private premises, and I think that greater efforts are made and demanded by the citizens in general that this must be done.

1895. One case of diphtheria. Whooping cough was very prevalent during a part of the winter and through the year until late fall. There were about 150 cases, some severe, but only two deaths resulted.—Levi C. Caldwell, Sec.

Shirley.

No contagious diseases for the two years. I should like to see a better system of water supply for our village. Some of our fine springs are on high hills three-fourths of a mile away; they are large and might furnish an abundant supply of pure water.—Henry Blackstone, Sec.

Sidney.

One nuisance removed. Nine cases of typhoid fever (nine houses), but diphtheria and scarlet fever have been absent. Whooping cough in November and December.

1895. Three nuisances removed. Several dead hogs were cast up on the shores of the Kennebec River, and these had to be buried at the expense of the town. Three cases of scarlet fever (one house); three of typhoid fever (three houses). Action was taken in accordance with the requirements of the law. The cases of scarlet fever were traced to a student who came home from the school at Oak Grove Seminary. He was a day scholar. This year, as well as the year before, free vaccination was offered to the public.—Dr. Daniel Driscoll, Sec.

Silver Ridge Plantation.

1895. There were three cases of typhoid fever (one house). Whooping cough was present from August to December.—Mrs. Emily L. Dow, Sec.

Skowhegan.

1894. One nuisance was reported to the board, and this was removed. We have had no cases of infectious diseases save one case of typhoid fever, which was imported, and a few cases of whooping cough and chicken-pox. For the further improvement of our sanitary condition additional sewer construction is needed, and a law compelling all householders to connect sink drains with the sewers, where these are provided.

The experience of this board suggests that measles, whooping cough, and chicken- pox should be reported and excluded

from the schools. All cases of tuberculosis should be reported, and the public should be protected from its infectious matter. All house plumbing and drainage should be done under the supervision of the local board of health or health officer, or by such competent workmen as have been certified by the State Board, after passing an examination, as being competent for doing such work. In towns where a system of sewers has been constructed, every householder should be required to properly connect with them, unless a private drain or sewer, satisfactory to the board of health, is maintained.

1895. About one dozen nuisances came to the attention of the board, all of which were removed. We have had two doubtful cases of diphtheria (two houses), and ten cases of typhoid fever (nine houses). The children in the questionable cases of diphtheria attended the Leavitt street school where the ventilation is wretched. In localities where typhoid fever has usually prevailed there have been no cases the past three or four years, which result may be attributed to sewerage, improved water supply, and sanitary supervision.—Dr. J. N. Merrill, H. O.

SMITHFIELD.

1894. No cases of infectious diseases, with the exception of two cases of whooping cough.

1895. Two cases of diphtheria (two houses). These cases were immediately looked after.—W. J. Haynes, Sec.

SMYRNA.

1894. One case of typhoid fever.—R. E. Timoney, Sec.

SOLON.

1894. No cases of infectious diseases reported this year.

1895. No cases of infectious diseases.—Dr. S. F. Greene, H. O.

SOMERVILLE.

1894. Two cases of diphtheria. All necessary care was taken to prevent their spreading.

1895. No contagious diseases.—Morrill Glidden, Sec.

South Berwick.

1894. Eight nuisances were removed. Seven cases of scarlet fever (seven houses); one of typhoid fever. Every effort was made to prevent the spreading of these diseases. Measles and whooping cough were present in a mild form. We believe that ice should not be secured from streams into which sewers enter. The ice supply for our town is taken from such a source, and I believe a law should be passed forbidding such supply.

1895. Twelve nuisances were removed. One case of diphtheria; three cases of scarlet fever (three houses); seven of typhoid fever (seven houses).—Geo. F. Clough, Sec.

Southport.

1894. One case of typhoid fever. It has been very healthy generally.

1895. No contagious diseases. The sanitary condition of our town would be improved by discontinuing the use of some wells.—W. N. Grover, Sec.

South Thomaston.

1894. Two nuisances were abated. Two cases of scarlet fever (one house); four of typhoid fever (one house).

1895. Three cases of diphtheria (three houses); twenty-two of scarlet fever (six houses). Strict quarantine has been required, and proper after-treatment has been carried out. Scarlet fever was brought from Massachusetts. In some of the cases of scarlet fever there was an almost entire absence of rash, but a severe sore throat was present, while others had the typical rash, but no sore throat.—Dr. Geo. C. Horn, Sec.

Springfield.

1894. One case of typhoid fever. Measles was present in February and March.

1895. No cases of contagious diseases excepting whooping cough and measles in September and October.—Geo. A. Lewis, Sec.

STACYVILLE PLANTATION.

1894. One nuisance was abated. Eight cases of diphtheria (two houses). The sick were removed to a hospital, and the rooms in which they were taken sick were disinfected.

1895. Two cases of diphtheria (one house); five of typhoid fever. In these cases we removed the well members of the families to an unoccupied house and kept them there until all danger of infection was past. Whooping cough was present in August and September.—Chas. E. Morrill, Sec.

STANDISH.

1894. Three nuisances abated. Two cases of diphtheria (two houses); eleven of scarlet fever (seven houses); five of typhoid fever (five houses). At Sebago Lake several cases of scarlet fever were so mild that no physician was called in and the children were often found on the street at play while desquamation was taking place. Scarlet fever appeared in the school at Richville and the Lake, and in both cases the schools were stopped and the buildings were fumigated by the board of health. —Dr. C. L. Randall, Sec.

1895. One nuisance was abated. Three cases of diphtheria (one house); two of scarlet fever (one house).—Dr. W. S. Thompson, Sec.

STARKS.

1894. Two cases of scarlet fever (one house). The board took steps to prevent its further spreading.

1895. One nuisance was abated. No cases of contagious disease.—C. M. Greenleaf, Sec.

STETSON.

1894. One case of typhoid fever. 1895. No cases of contagious diseases.—T. J. Cleveland, Sec.

STEUBEN.

1895. One nuisance reported to the board was investigated and it was found that the report was ill-founded. No cases of contagious disease.—B. W. Stevens, Sec.

St. Albans.

1894. Three cases of typhoid fever (three houses).

1895. One nuisance removed. One case of typhoid fever. Every precaution was taken by the attending physician.—S. B. Prescott, Sec.

St. George.

1894. One nuisance abated. Eight cases of scarlet fever (five houses); two of typhoid fever (two houses).

1895. We have had twelve cases of diphtheria (five houses); and one case of scarlet fever. The houses in all cases have been quarantined.—Dr. F. O. Bartlett, Sec.

St. John Plantation.

1895. No cases of contagious disease.—W. M. Cyr, Sec.

Stockton Springs.

1895. Three or four cases of scarlet fever in one house.—Dr. Geo. A. Stevens, Sec.

Stoneham.

1895. Eight cases of scarlet fever (one house); and one doubtful case of typhoid fever. We have acted promptly in these cases and have done everything that the law requires. Whooping cough broke out in September; there have been about twenty cases of that disease.—N. M. Russell, Sec.

Stow.

1894. We had one case of typhoid fever in November, and fourteen cases of measles in April and May.

1895. No cases of contagious diseases reported.—Leonard Emerson, Sec.

Strong.

1894. No cases of contagious disease. 1895. One case of scarlet fever which the board attended promptly after it was reported.—M. A. Will, Sec.

SULLIVAN.

1894. Two nuisances were abated. Eight cases of scarlet fever (three houses). These cases were looked after by the board as the law requires. Tonsillitis was present during the spring months, and mumps during the latter part of the year. The town has been quite free from epidemic diseases the past year. The utility of the board of health has been well exemplified in this town in restricting the spread of contagious and infectious diseases. We have no such widespread epidemics as were not unusual before its establishment.

1895. Two nuisances abated. No cases of diphtheria, scarlet fever, or typhoid fever. Measles and whooping cough during the spring and early summer months. One case of cerebro-spinal meningitis.—Dr. F. W. Bridgham, H. O.

SUMNER.

1894. One case of typhoid fever; this is all we have had of contagious diseases. We have been remarkably free from diseases.

1895. One nuisance was remedied. We had two mild cases of diphtheria (one houses); and one case of typhoid fever. The children in one family had measles. A man over seventy years of age in this family, who had never had the disease, did not take it.—Sharon Robinson, Sec.

SURRY.

1895. Two nuisances removed. One case of scarlet fever; two of typhoid fever. Action was taken as recommended by the State Board. Whooping cough entered the town.—H. J. Milliken, Sec.

SWAN'S ISLAND PLANTATION.

1894. Two cases of scarlet fever (two houses); three of typhoid fever (three houses).—Dr. H. W. Small, H. O.

Swanville.

1894. No contagious diseases the past year. Our town is in good condition, the general health good, the drainage good. —L. L. Downs, Sec.

1895. No contagious diseases.—A. H. Ellis, Sec.

Sweden.

1894. There have been no cases of contagious diseases.— N. O. McIntire, Sec.

1895. One case of typhoid fever in a mild form. A very few cases of whooping cough.—Geo. S. Marr, Sec.

Talmage.

The board has not been called upon to act for the past two years. We have had no infectious diseases.—F. R. Neal, Sec.

Temple.

1894. One nuisance removed. One case of typhoid fever.— M. B. Huse, Sec.

1895. One case of diphtheria. Whooping cough was prevalent in July and August.—W. I. Butterfield, Sec.

The Forks Plantation.

1895. No infectious diseases.—W. S. Powell, Chr.

Thomaston.

1894. We have a good public water supply. The system of drainage and sewerage has been continued this year. A large number of nuisances were reported to the board, all of which were removed. We have had no cases of diphtheria or scarlet fever, but there were eleven cases of typhoid fever (eight houses). The experience of this board suggests that it would be better if the law were more explicit in regard to what constitutes a nuisance.

1895. The work on our sewerage continues. Several nuisances were removed. We have had seven cases of diphtheria

(three houses); five of scarlet fever (two houses); and one of typhoid fever. These cases are attended to promptly in accordance with the requirements of the law.—Dr. H. C. Levensaler, H. O.

TOPSFIELD.

1894. Our board is always ready for action, but we have had no contagious diseases.

1895. No contagious diseases excepting measles in the spring.—O. H. Taylor, Sec.

TOPSHAM.

1894. Three nuisances removed. Four cases of scarlet fever (four houses); six of typhoid fever. Whooping cough in December. A woman from this town went to Massachusetts with her daughter, and the latter contracted scarlet fever in a mild form. The Massachusetts authorities let her come home in two weeks. As soon as I learned of the facts the house was placarded and the girl was kept from school eight weeks. A dog was sold from this house, and a boy in the house to which the dog went contracted scarlet fever; whether from the dog or not I am not sure.

1895. Six cases of scarlet fever (four houses); five cases of typhoid fever (two houses). Prompt action is taken when contagious diseases are reported. Measles in December.—Dr. H. O. Curtis, Sec.

TRENTON.

1894. One case of measles which was isolated so that the disease did not spread. The health of the people of this town is good.

1895. No contagious diseases, with the exception of several cases of measles and several of whooping cough.—Pearl L. Leland, Sec.

TRESCOTT.

1894. Our town has been greatly blessed in having no cases of contagious disease. 1895. No contagious diseases..—John Saunders, Sec.

Troy.

1895. One nuisance removed. No infectious diseases.—Dr. Mark T. Dodge, H. O.

Turner.

1894. One nuisance removed. Five cases of diphtheria (five houses); twenty-four cases of scarlet fever (fifteen houses). Cases are quarantined and furnished with circulars of instruction at once.

1895. Two nuisances were reported. One case of diphtheria; nine of scarlet fever (seven houses). One schoolhouse was closed two weeks, and the schoolhouse was disinfected.—J. P. Waterman, Sec.

Union.

1894. One case of diphtheria. Precautions were observed to prevent the spread of the disease. It has been a very healthy year.

1895. A company has been formed, and water has been brought to the village from springs three-fourths of a mile away. Four cases of diphtheria (two houses); one case of scarlet fever. —E. R. Daniels, Sec.

Unity.

1895. No infectious diseases.—Dr. O. R. Emerson, H. O.

Unity Plantation.

1894. No contagious diseases.—C. N. Decker, Sec.

1895. No contagious diseases, with the exception of a few cases of mumps.—J. B. Getchell, Sec.

Upton.

1895. Entire absence of infectious diseases.—H. I. Abbott, Sec.

Vanceboro.

1894. One nuisance removed. Three cases of typhoid fever. —Chas. Cobb, Sec.

1895. One nuisance removed. Five cases of scarlet fever (five houses); four of typhoid fever (four houses). Houses

were placarded and arrangements made to keep the patients isolated. Our first case of typhoid fever was brought from abroad; the others, no doubt, had local origin and can be traced, we think, to infected water. One was a section man whose work brought him in contact with excreta dropped by fever patients passing on the trains (and there were many) every day. Another was a workman who, no doubt, drank water from the river below the outlet of a sewer.—G. M. B. Sprague, Sec.

VASSALBORO.

1894. Six cases of diphtheria (two houses); one of typhoid fever. The secretary has immediately attended to the cases, placed them under quarantine, and in cases of death has personally superintended the burial.

1895. Four nuisances reported, and all were attended to. We had five cases of diphtheria (two houses); twenty-four cases of scarlet fever (nine houses); six of typhoid fever (three houses). —Henry D. B. Ayer, Sec.

VEAZIE.

1894. Three nuisances were removed. Six cases of typhoid fever. Four of the cases of typhoid fever, in one house, were caused by polluted water, so the doctor reported.—Frank J. Dudley, Sec.

1895. Three nuisances were removed. Fourteen cases of diphtheria (nine houses). We have placarded every house as soon as notified.—Geo. W. Frost, Sec.

VERONA.

1894. One nuisance removed. We act at once when infectious diseases occur, but we have had none the past year.—A. H. Whitmore, Sec.

VIENNA.

1894. One case of typhoid fever. Whooping cough during May and June.

1895. Two nuisances removed. One case of typhoid fever, attended to immediately.—L. C. Davis, Sec.

Vinalhaven.

1894. Eight nuisances removed. Twenty-eight cases of scarlet fever (thirteen houses). The families were isolated, the schools were closed, and the public library was closed. There were a few cases of measles in January.

1895. Thirteen nuisances were removed. We had about forty non-fatal cases of scarlet fever. Measles in September. We believe scarlatina has been extended by means of free text books and the public library. In our epidemic of scarlet fever the disease was of so mild a character that the parents supposed it to be measles, and did not call in a physician. We at last discovered it by accident, but not until many children had become infected. Many had both scarlatina and measles.—Dr. E. H. Lyford, Sec.

Wade Plantation.

1894. One nuisance removed. No infectious diseases.

1895. Two nuisances removed. Whooping cough early in September.—Llewellyn Curtis, Sec.

Waldo.

1895. Six cases of diphtheria (two houses); four of scarlet fever (one house)—J. G. Harding, Sec.

Waldoboro.

1894. Twenty cases of scarlet fever (ten houses); four of typhoid fever. There has been very little sickness; the scarlet fever was in a mild form.—Dr. F. M. Eveleth, Sec.

1895. One nuisance was removed. Fourteen cases of diphtheria (six houses); one of typhoid fever. There have been three cases of cerebro-spinal meningitis. Two of the schools were closed on account of diphtheria. The schools were thoroughly disinfected. We have carefully looked after the water-closets connected with the schools, and have taken special care to have a supply of good pure water for the pupils to drink. —Dr. J. T. Sanborn, Sec.

Wales.

1894. No contagious diseases.—Alden Moulton, Sec.

1895. No contagious diseases.—E. A. Ham, Chr.

Wallagrass Plantation.

1895. No contagious diseases. One nuisance removed, a horse which was thrown into Fish River. Formerly all kinds of nuisances of this kind, cattle and everything would be left along the road or in the river. Now people are more careful not to produce such nuisances.—McGloire Michaud, Sec.

Waltham.

1894. Three cases of scarlet fever in one house. The board of health visited the house and looked after the case.

1895. We have had no infectious diseases, with the exception of measles in July. This has been a very healthy town the past year.—Mrs. Hannah Fox, Sec.

Warren.

1894. One case of typhoid fever.

1895. One mild case of diphtheria; eight cases of scarlet fever in a mild form (two houses). Every precaution has been observed that the law requires. Very little sickness during the past year.—Dr. J. M. Wakefield, Sec.

Washburn.

1894. One nuisance removed. Four cases of typhoid fever (four houses). Due precautions were taken.

1895. One nuisance removed. Five cases of scarlet fever (two houses). Strict quarantine and thorough disinfection enforced. Whooping cough was present.—Dr. H. S. Sleeper, Sec.

Washington.

1894. One nuisance was abated. Two cases of scarlet fever (one house).

1895. One nuisance was removed. One case of diphtheria; three of scarlet fever (one house); two of typhoid fever (two houses). Houses were immediately quarantined so that mingling with the general public was prevented. The one case of diphtheria was brought by a young man who supposed himself to be suffering from a slight sore throat.—T. S. Bowden, Sec.

WATERBORO.

1894. One nuisance abated. One case of typhoid fever.

1895. We have had no cases of infectious diseases.—J. L. Chadbourne, Sec.

WATERFORD.

1894. Two nuisances removed. Three cases of diphtheria (three houses); three of scarlet fever (two houses). Measles was quite prevalent from March to May.

1895. Two cases of diphtheria (two houses).—Dr. F. S. Packard, Sec.

WATERVILLE.

1894. We had seventeen cases of diphtheria; two of scarlet fever; and six of typhoid fever. Houses have been immediately placarded, and every precaution taken. German measles was present.

1895. There has been a general development of the sewerage system. Sixteen cases of typhoid fever (thirteen houses); four cases of typhoid fever (two houses). Whooping cough has been generally prevalent.—Harvey D. Eaton, Sec.

WAYNE.

1894. No infectious diseases, with the exception of one case of typhoid fever.

1895. No contagious diseases.—Dr. F. L. Chenery, Sec.

WEBSTER.

1894. Some improvements in the drainage at Sabattus have been made. Five nuisances have been removed. One case of typhoid fever, but none of diphtheria or scarlet fever.

1895. About 100 feet of sewer pipe have been laid in the village. Three nuisances were abated. Two cases of diphtheria (one house); and one of typhoid fever. Measles and whooping cough were prevalent in the fall and winter.—James G. Jordan, Sec.

WEBSTER PLANTATION.

No contagious diseases in the two years.—Chas. D. Cole, Sec.

WELD.

1894. No contagious diseases or nuisances reported during the year.—H. B. Austin, Sec.

WESLEY.

1894. Only one nuisance and that was removed. No contaious diseases.

1895. No cases of infectious diseases save one of diphtheria —Samuel Hawkins, Sec.

WESTBROOK.

1894. Seven nuisances were reported to the board, five of which were removed. Three cases of diphtheria (three houses); five of scarlet fever (four houses); nine of typhoid fever (seven houses). In these cases precisely such action as the law requires was taken.

1895. There has been a meeting or conference of the local board almost every week in the year. Two nuisances were abated. Four cases of diphtheria (three houses); thirty-seven of scarlet fever (thirty houses); seven of typhoid fever (five houses).

In connection with infectious cases the house is usually visited and, besides others measures, inquiry is made whether any books remain in the house belonging to any library or school, and whether cats or dogs are going in and out at pleasure. We usually recommend that carpets, rugs, etc., be taken out of the rooms early in the history of the case, and give such hints as are needed. Why so many cases of scarlet fever have been present is accounted for with the theory, which seems to be well

supported, that there were two or three cases so mild that no physician was called.

Antitoxin is provided at the public expense in cases of diphtheria. The cleaning of privy vaults by the barrel method, and the use of deodorizers give satisfaction, and there is a great improvement on the former method.—H. K. Griggs, Sec.

WESTFIELD PLANTATION.

1895. One nuisance was removed. Three cases of scarlet fever (one house); eight of typhoid fever (five houses). Whooping cough was present. The typhoid fever cases were traced to one polluted well.—C. M. Tompkins, Sec.

WEST GARDINER.

1894. No infectious diseases.

1895. Four cases of diphtheria (three houses); two of scarlet fever (two houses).—Frank E. Towle, Sec.

WESTMANLAND PLANTATION.

1894. No contagious diseases.—Erick Lindburg, Sec.

WESTON.

1895. No contagion present.—G. W. Moody, Sec.

WHITEFIELD.

1894. There has been no case of contagious disease excepting one case of mumps.—G. A. Moody, Sec.

1895. One nuisance removed. One case of diphtheria.—Marcellus Philbrick, Sec.

WHITING.

1894. No contagious diseases.—W. H. Leighton, Sec.

1895. Ten cases of typhoid fever (five houses). Houses were visited and directions given for cleansing the premises, and disinfectants were furnished.—F. A. Bucknam, Sec.

WHITNEYVILLE.

1894. We had five cases of scarlet fever (three houses).

1895. Twenty-six cases of scarlet fever (eight houses). We placarded the houses and posted up notices at the post office and other public places, and warned the inmates of each house of the danger of exposing others to the contagion. We have encountered some who persisted in calling on infected neighbors against every admonition, and feel confident that at least twenty of the cases reported were contracted in this way. Whooping cough and measles in the latter part of the year. We feared that the epidemic of scarlet fever came from a schoolhouse and we disinfected the school rooms and books, but afterwards we had reason to believe it was brought from Jonesboro by a woman who visited in this town.—Chas. H. Sullivan, Sec.

WILLIAMSBURG.

1894. There has not been a case of infectious disease in town, save two of whooping cough.

1895. One case of typhoid fever.—R. J. Williams, Sec.

WILLIMANTIC.

1894. No contagious diseases. 1895. One nuisance abated. Nothing infectious this year.—C. C. Norton, Sec.

WILTON.

1894. Six cases of scarlet fever (three houses). These cases were looked after.

1895. Four cases of typhoid fever. The sanitary conditions were investigated.—Dr. A. B. Adams, Sec.

WINDHAM.

1894. Eight cases of scarlet fever (five houses).

1895. Diphtheria, two cases (one house); scarlet fever, three cases (one house); typhoid fever, one case. The board has general supervision of quarantine and disinfection.—Dr. I. D. Harper, Sec.

WINN.

1894. One case of typhoid fever. Whooping cough in the fall.

1895. There are some old tannery vats open here in our village from a tannery burned in 1892, and there is some question as to whether their influence is unhealthful or not. One case of diphtheria. The house was placarded and all precautions taken to stop the disease.—M. F. Scott, Sec.

WINSLOW.

1894. Four nuisances abated. Four cases of diphtheria (three houses); one of scarlet fever, and one of typhoid. Strict quarantine and other measures enforced.

1895. Six cases of diphtheria (four houses). Whooping cough in November and December.—Geo. W. Patterson, Sec.

WINTERPORT.

1894. One case of scarlet fever; three of typhoid (three houses). The houses were placarded, the cases were isolated, and disinfection was attended to after recovery.

1895. We had no cases of infectious diseases, with the exception of one of typhoid fever. All the schoolhouses in town are poorly heated and abominably ventilated.—Dr. C. F. Atwood, Sec.

WINTHROP.

1894. Pure spring water has been introduced by aqueducts to a large number of the inhabitants of the village. Drainage and sewerage have been looked after. Five nuisances abated. One case of diphtheria; one of scarlet fever. In March and April a few cases of whooping cough and measles. One accident occurred from the upsetting of a kerosene lamp; an old man was severely and dangerously burned.

1895. Twelve nuisances were removed. No infectious diseases have been reported. Several cases of measles in September, and chicken- pox and mumps have been quite prevalent in the latter part of the year.—Dr. C. A. Cochrane, H. O.

WISCASSET.

1895. Two nuisances were abated. We have had no infectious diseases save measles and whooping cough.—Dr. S. A. Stephens, H. O.

WOODLAND.

1894. No infectious diseases.—D. A. Snowman, Sec.

1895. One nuisance abated. Six cases of scarlet fever (three houses); five of typhoid (two houses).—Moses P. Abbott, Sec.

WOODVILLE PLANTATION.

1894. No contagious diseases. 1895. We have been free from epidemic diseases.—John Pond, Sec.

WOOLWICH.

1895. There have been no contagious diseases.—A. B. Thwing, Sec.

YARMOUTH.

1894. A special committee was chosen by the town to investigate as to the source, supply, cost, etc.,of a water supply for the village. Six nuisances were abated. Eleven cases of diphtheria (five houses); thirteen of scarlet fever (ten houses); eight of typhoid fever (eight houses). The printed instructions of the State Board have been carried out to the letter.

1895. The town has just completed a system of pure spring water supply, which is brought through nearly six and one-half miles of pipes, and we have laid about 10,700 feet of glazed sewer pipes, five to twenty-four inches in size, and the town owns the plant. Eight nuisances have been abated. Seven cases of scarlet fever (six houses); two of typhoid fever (two houses). I have attended to these cases in person.

Since the organization of the local board of health we have found that our people have been educated up to looking better after their premises so that our work is much lightened, and a better feeling exists than formerly.—R. Harding, Sec.

YORK.

1895. Three cases of scarlet fever (one house). We shall be able to report a system of water works next year.—Dr. W. L. Hawkes, H. O.

SPECIAL PAPERS.

FORMIC ALDEHYDE—ITS PRACTICAL USE.*

By F. C. Robinson,

Professor of Chemistry at Bowdoin College, Brunswick, Me.

To those engaged in public health work, no argument need be presented to prove the pressing need of an efficient gaseous disinfectant, which can be conveniently and safely used, which will destroy all dangerous germs and not injure clothing, paper, or other substances which may be present.

Hitherto, sulphurous acid has most nearly met these requirements, but far from perfectly. In the first place, it has little or no germicidal action unless in presence of moisture, and in the second, it so rapidly oxidizes to sulphuric acid that paper and fabrics are frequently injured by its use. Then, too, it acts so powerfully upon the lungs, that rooms in which it has been used are for a considerable time uninhabitable.

So serious have been the evils associated with sulphur fumigation that some health boards have given up its use, preferring to rely upon soap and water, bi-chloride of mercury, and other liquid disinfectants, notwithstanding the inconvenience attending their use in disinfecting a room.

In view of these conditions, it has been with more than passing interest that we have read of the recent experiments with the material called formalin, but known in chemistry as methyl aldehyde or formic aldehyde. The remarks of Dr. Kinyoun at the Denver meeting of this association stimulated this interest

* Read before the meeting of the American Public Health Association, Buffalo, N. Y., October, 1896.

still more, and probably at this time very many of you have personal experiences with it to relate. Very early in the past year the Maine State Board of Health authorized me to conduct a series of experiments to determine, if possible, the practicability of its use as a gaseous disinfectant by local boards of health. It is the nature and result of these experiments which I shall give in this paper.

It was not the design of the Board to have me simply verify or disprove the antiseptic properties of formic aldehyde. We could not but have confidence in the work done in foreign countries bearing upon this point. The main question was, can this material be put into the hands of local boards of health, so that we can have confidence in their results? It is one thing to use a material in a scientific laboratory and an entirely different thing to use it in a tenement-house. The professor of hygiene and the average member of a local board of health are naturally different in mental equipment.

Early in my investigations I became impressed with the fact that the successful use of formic aldehyde as a general room-disinfectant necessitated the formation of very large quantities of it in a short time and that this must be obtained in a comparatively dry condition.

It is well known that the commercial formic aldehyde, sold also under the name of formalin and other proprietary names, is a water solution of the gas, containing about forty per cent. of the pure substance. This smells strongly of the aldehyde, and in small spaces can be readily used as a source of the gas by pouring it upon the sponge or cloth and allowing it to evaporate, which it very readily does.

By so treating a large room, say fifteen feet square, it can be filled with the gas, using, of course, large quantities of the solution. But for some reason the penetrating power and disinfecting action of the gas so prepared, at least in my experiments, is not satisfactory. I do not suppose that the gas is any different in such a case, because in a small space it is perfectly effective, but I imagine that, coming off as it then does, loaded with moisture and cooled by the process of evaporation, it is

more sluggish in its movements and penetrates less readily all parts of the space.

It is also true that the use of a very large amount of the solution involves considerable expense.

I next turned my attention to proposed methods of generating the gas directly. This part of the subject has not been neglected by foreign workers.

I will say by way of introduction to it, that the word aldehyde in chemistry is a class name. There are a great many substances to which it is given. In general it is an alcohol dehydrogenated; hence the name al-de-hyde. As a rule an alcohol becomes an aldehyde when by action of oxygen, in limited amount, it loses two atoms of its hydrogen. Methyl aldehyde, ethyl-aldehyde, etc., are thus derived from methyl and ethyl alcohols. But because the aldehydes very easily change into acids they more commonly take their names from the resulting acids, and hence the above aldehydes are called formic, and acetic.

The chemical formulae show very clearly the change. Thus methyl alcohol $C\ H_3\ O\ H$ becomes by loss of hydrogen $C\ H\ O\ H$, formic aldehyde, and that, by addition of oxygen, becomes $C\ H\ O\ O\ H$, formic acid.

Methyl alcohol is made from dry distillation of wood, and used in the arts under the name of wood-spirit or wood-alcohol.

The change of an alcohol to an aldehyde may be brought about in a variety of ways. In the making of vinegar a portion of the alcohol is generally changed to aldehyde, spontaneously. Alcohols heated with certain higher oxides, as of chromium and manganese, are changed to aldehydes. But the most successful and easiest way of making the two above mentioned aldehydes is to expose the vapors of the corresponding alcohols, mixed with air, to red-hot platinum. In this way formic aldehyde was first made by Hoffman, in 1867. The process can easily be seen by suspending a spiral of thin platinum wire or small piece of sheet platinum over the wick of an ordinary spirit lamp. If the lamp be lighted and then quickly extinguished, the platinum will continue to glow and the aldehyde odor become

manifest. This will produce, of course, formic or acetic aldehyde, according to the alcohol used,—common alcohol giving acetic aldehyde, wood-alcohol giving formic aldehyde. It is upon this principle that lamps have been devised by several foreign scientists to make formic aldehyde for room disinfection. Gambier and Brochet describe such a lamp in the *Revue D'Hygiene*, February 20, 1895. The wick is made as large as possible, and a cone or cap of platinum, perforated, is put over it. The oil is held in a tank at one side, on the principle of a student lamp. With this lamp 100 c. c. of methyl alcohol can be changed to formic aldehyde in an hour. As this is not rapid enough to disinfect ordinary rooms, they had batteries of lamps constructed so that with eight of them 800 c. c. per hour could be changed.

Tollens, in the *Bericht der Deutschen Chemischen Gesellschaft*, describes a lamp on the same general lines but without the air regulator chimney and tank. It seems to be an ordinary spirit lamp with a cone of platinum gauze over the wick.

Trillat in the *Revue D'Hygiene* for August, 1895, describes a large lamp in which several liters of the alcohol were vaporized by heating the copper cylinder containing it, and the vapor made to pass through capillary openings, and then mixed with an air impinge on hot platinum, or copper, or platinized asbestos. He was enabled to change six liters of alcohol to aldehyde in a few hours. But, of course, this lamp or apparatus required an arrangement for boiling the alcohol.

Dr. A. Diendonnè in the *Arbeiten aus dem Kaiserlichen Gesundheitsamte*, third part, 1895, describes a lamp devised by himself and Herr Krell in which the ordinary soldering lamp of the plumber has a platinum cylinder attached to it, so that having first been kindled in the usual manner and the platinum heated, it is then extinguished, and the platinum causes the change into aldehyde to continue as long as the lamp contains alcohol. This lamp has been introduced into this country and is made in three sizes, changing 90 c. c., 200 c. c., 300 c. c. of alcohol to aldehyde per hour.

When I began to experiment, only the Tollens, Gambier and Brochet, and Trillat lamp had been described, and neither of them, so far as I could find, was for sale in this country.

It seemed to me, also, that neither of these could come into general use, for neither made it possible to easily generate the aldehyde in sufficiently large amount. The same objection also applies to the Krell lamp, though it is evidently an improvement upon the others.

My first attempt at a solution of the problem was to use an ordinary lamp with thin platinum, or platinized asbestos, above or surrounding the wick. I found the asbestos better than sheet platinum, but did not succeed in making, in this way, a satisfactory apparatus as to quantity of gas and ease of use. I later devised the following:

I take a disc of moderately thick asbestos board and have it perforated with small holes close together. This is then platinized in the usual way, using quite a strong solution of platinic chloride. If now a shallow dish, cylindrically formed, and of such size that the perforated asbestos disc will just cover its top, be partly filled with methyl alcohol, it serves as the lamp font. If the platinized disc be wet with the alcohol, seized in a pair of forceps or small tongs, removed from the dish, and the alcohol lighted, it will, by the time its alcohol burns away, be heated sufficiently, so that when placed over the lamp font again it will continue hot and change the alcohol to aldehyde.* Experience shows that with proper depth of dish and suitable holes for admission of air, the disc keeps of a proper redness to bring about the change most efficiently. In order to avoid all chance of the alcohol catching fire, and to provide for regulation of the air supply, I have it constructed in accordance with the sample I have here with me. (Prof. Robinson here exibited his apparatus and explained its construction).

The advantage of this apparatus is, that it is easily used and the amount of alcohol changed in a given time depends upon the size of the disc. A disc about six inches in diameter serves to change a liter per hour, and this is about as much as is ever

* For better method of starting see another page in this report.

wanted. I think, also, that this form of apparatus gives a larger yield of aldehyde than any other. It exposes a much larger surface of platinum to the alcohol and air than any other, and keeps it of a more uniform temperature; and I have no doubt but what this is the reason why my experiments show a less amount of alcohol needed to disinfect a room than those of Trillat. I am very sure that the blast form of lamp as devised by Krell must discharge considerable amounts of alcohol unchanged; in fact, I know it does, for I constructed such a form of apparatus after abandoning the wick lamp, and tested it to my satisfaction. Having constructed a lamp in the manner described, I next undertook a series of experiments, which in general tended to confirm the results of others. I will speak only of those which had to do with room disinfection.

I selected a room containing about 3,000 cubic feet and having three large windows with very loose sash. I found that one liter of alcohol used and the room closed for four hours was not enough to completely sterilize infected matter, if it was covered up or concealed to any great extent, but when two liters were used, or even one and a half, complete sterilization resulted in about three and one half hours. I mean complete destruction of diphtheria and typhoid cultures, and no turbidity in any of the cultures within two days. Occasionally, after five or six days, a slight growth of the hardier molds would appear in some of the cultures, as other observers have noticed.

The remarkable penetration of the substance was shown by the fact that all parts of clothing, including seams, inside of pockets, etc., were sterilized in all parts of the room. Typhoid bacillus was destroyed even when buried half an inch deep in sand.

But, perhaps, the most remarkable results were obtained from bedding. Cultures of typhoid and diphtheria were placed under the clothes, under the pillows, and even within the mattress, and found killed by two liters of alcohol in seven hours. The same result was obtained when cultures were rolled up in a mattress and the whole tied into as compact a bundle as possible.

The reason of the remarkable penetrating power of the gas is undoubtedly in the fact that when hot it is of almost the same specific gravity as air, and hence, readily mixes with air and has no tendency to separate out. But, while its specific gravity is favorable to its penetration, it is also favorable to its escape from a room; hence it is very quickly removed from a room upon opening doors and windows. It also escapes readily from all leaky places in a room. This is why results in small, close chambers or boxes are far different, in amount needed, from those in large rooms.

The more open the room, the more must be used. It is for this reason that I am of the opinion that effective house disinfection cannot be most economically done by generating the gas in a single room and allowing it to pass through open doors and stairways. In my judgment, three quarts burned in three different parts of a house would be as effective as six burned in one place. It is, however, rather rare that a whole house needs disinfecting. Commonly a single suite of rooms, not more than two in number, are infected. Two quarts of alcohol burned in one of them and the rooms kept closed for from three to four hours would, I think, be sufficient.

I do not believe that it would be at all safe to burn less than a quart in any ordinary living room. (It will be noticed that the room I used was considerably larger than an ordinary house room). As I said at the beginning, I do not intend to weary this Association with details of experiments, but have confined myself to results. In the report of the Maine State Board of Health, all details will be given for future reference. I will, however, note some of the most interesting articles which have been written on the subject, for the benefit of those who may wish to consult them.

I will add, also, that the bacteriological work was done by my assistant, Dr. B. L. Bryant, and that we have made experiments upon book disinfection and other uses of formaldehyde, which we hope to publish later.

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EXPERIMENTAL WORK WITH FORMIC ALDEHYDE.

By F. C. Robinson,
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In the fall of 1895, at the suggestion of the secretary, Dr. A. G. Young, the Maine State Board of Health asked Prof. F. C. Robinson to conduct experiments upon formaldehyde as a disinfectant, and to report the results to the board. In conjunction with a bacteriologist, B. L. Bryant, he has worked upon it until the present time, and submits the following report, first calling attention to other experiments and then detailing those made in his own laboratory.

TESTS IN OTHER LABORATORIES.

Slater first attempted to determine the amount of formic aldehyde necessary to inhibit the growth of specific micro-organisms. He added formalin to tubes of bouillon so that they contained from 1-2000 to 1-20000 of that liquid. These tubes were then inoculated with the micro-organism to be tested and placed in the incubator. B. typhosus showed no growth in 1-15000; B. coli communis, 1-7000; Sp. cholerae, 1-20000; B. anthracis, 1-15000. In those tubes in which growth appeared it was very much retarded and scanty.

The time required to kill the different germs with a one per cent. solution of the formalin was then tried. Staph. pyogenes aureus was killed in between 50-60 minutes; B. typhosus, 40-50 minutes; B. coli communis, 30-40 minutes; B. anthracis, less than 15 minutes; Sp. cholerae, less than 15 minutes.

Experiments were made to see how far these solutions might be made to replace the 1 or 2 per cent. solutions of carbolic acid,

sometimes used for preliminary disinfection of soiled clothes before washing. Soiled clothes from the postmortem room, and sterilized clothes soaked in cultures were left from twenty to twenty-four hours in a one per cent. and a 1-1000 solution. After washing in sterilized water, they were examined by cultivation.

Clothes from postmortem room,	1-100,	sterile;	1-1000,	not sterile.
" soaked in B. typhosus,	"	"	"	sterile.
" " Sp. cholerae,	"	"	"	"
" " Staph. pyogenes aureus,	"	"	"	"

The solutions have no bad effects upon clothes and are efficient as antiseptics, especially the 1-100 solution, and the more so in practice, for the adherent aldehyde would not be removed. Slater also tried some experiments with the vapor formed by evaporating the aldehyde solution under a bell-jar to which he exposed the cultures dried upon glass slips. B. typhosus, coli communis, B. prodigiosus, and Sp. cholerae were killed in less than ten minutes, and Stap. pyogenes aureus in less than 20 minutes.

Cambier and Bochet succeeded in making a lamp which would generate the gas directly from the methyl alcohol for room disinfection. They carried on their experiments in a room of 75 cu. metres in capacity, having two doors and three windows, and in bad state of repair. At each experiment a known amount of alcohol was burned and the room closed for twenty-four hours. At the end of that time the room was opened and cultures made from the dust in sterilized bouillon. From their tabulated results, they show that relatively small amounts of the gas are sufficient to kill nearly all the germs found in the dust of a room. Where organisms have been developed afterward, they have been almost always the very harmless B. subtilis, found in infusions of hay. Dust was also placed in watch-glasses at different heights within a closed cupboard and the gas, penetrating, sterilized the whole. B. tuberculosis they were unable to destroy. Those organisms that re-

sisted the first exposure to the gas were generally destroyed by the second.

To M. Trillat is due the most credit for thorough trial of the gas in room-disinfection. Not only did he try the effect upon the germs present in common dust, but also upon the more common pathogenic forms. The experiments he made were the most practical possible. For pathogenic microbes, B. anthracis, B. tuberculosis, B. diphtheriae and Stap. pyogenes aureus were chosen. Virulent cultures of these organisms having been selected, they were distributed upon small pieces of cloth by dropping a few drops upon each piece and drying in an oven.

The experiments were carried on in rooms upon the same floor and in rooms upon different floors. The bits of cloth and other infected things were distributed in different places, some upon the floor, some at a certain height, some near and others at a distance from the apparatus. The chimneys were closed and the windows, without extra precautions, and the lamp used for a variable number of hours. Observations were also made upon the influence of different temperatures upon the disinfecting power of the vapor, the least time of action necessary for the absolute disinfection of the pathogenic germs, the influence of the nature and disposition of the different objects, and the effect upon the various kinds of germs under the action of the vapors.

Series A, 10 trials.

Only a part of one floor was used in these experiments. Alcohol burned, 6 litres. Temperature, 13 degs. Cent. Dimensions of the place, 150 cu. metres. Bacteria used, those of saliva, of sewer water, and anthrax. Time of exposure, nine hours.

Observations upon the cultures:

		2 days.	10 days.	15 days.
B. salivae,	3 trials,	sterile.	sterile.	sterile.
B. anthracis,	4 trials,	"	"	1 not sterile.
Sewer water,	3 trials,	"	1 not ster.	2 " "

Stap. pyogenes aureus.

	2 days.	4 days.	12 days.
1-5	No growth.	No growth.	No growth.
1-10	"	"	"
1-20	"	"	"
1-50	"	"	"
1-100	"	"	"
1-300	"	"	"
1-500	"	Light growth.	Light growth.
1-1000	"	"	"
1-2000	Light growth.	"	"
1-5000	"	"	"

Two controls, heavy growth throughout.

B. typhi abdominalis.

	2 days.	4 days.	12 days.
1-5	No growth.	No growth.	No growth.
1-10	"	"	"
1-20	"	"	"
1-50	"	"	"
1-100	"	"	"
1-300	"	"	Growth.
1-500	"	"	"
1-1000	"	Growth.	"
1-2000	"	"	"
1-5000	"	"	"

Two controls, heavy growths.

Six petri dishes with film of gelatin, inoculated with Sp. cholerae Asiaticae, were sprayed with an atomizer with the following solutions of formalin and examined after five days.

1-100	Faint growth around the edges.
1-500	Same.
1-1000	Same.
1-2000	Completely liquified.
1-5000	Same.
1 control	Same.

The spray did not hit about the edges very well.

Made 5 cultures in agar in petri dishes of B. typhi abdominalis. These were exposed to the direct action of the gas, con-

ducted from a generator into a closed vessel for the following periods:

	2 days.	7 days.
30 min.	No growth.	No growth.
45 "	"	"
60 "	"	"
75 "	"	"

Control, heavy growth. These were incubated at 36 degrees for 2 days.

Tubes were filled with sterile bouillon, and enough formalin dropped in to make solutions of the following percentages. These were then inoculated with pyog. aureus, typhi abdominalis, and coli communis.

	3 days.	8 days.
1-5000	Sterile.	Sterile.
1-7000	"	"
1-10000	"	"
1-13000	"	"
1-20000	"	"
1-25000	"	"

Several grammes of dust were swept from the laboratory floor, from which two controls were made. The remainder was placed in a closed vessel exposed to the gas from a generator and cultures made by dropping a little of the dust into sterile bouillon after the following periods of exposure:

		4 days.
30 min.	2 tubes,	Turbid.
60 "	"	"
2 hours,	"	Sterile.
3 "	"	"
4 "	"	1 sterile, 1 turbid.
5 "	"	Sterile.
15 "	"	"
17 "	"	"

Two controls, very turbid.

Six cultures of typhoid were made in petri dishes and sprayed with solutions of formalin. They were incubated at 36 degs. for 36 hours. Examined after 3 days.

1-50	No growth.
1-100	" "
1-500	" "
1-1000	Retarded growth.
1-2000	" "

Control, heavy growth.

Same as above inoculated with coli communis.

1-50	No growth.
1-100	Retarded growth.
1-500	Heavy about edges.
1-1000	Heavy growth.
1-2000	" "
1 control,	" "

Same inoculated with Sp. cholerae Asiaticae.

1-50	No growth.
1-100	" "
1-300	" "
1-500	" "
1-1000	Heavy growth.
Control,	" "

Same inoculated with pyogenes aureus.

1-50	Slight about edges.
1-100	" " "
1-300	" " "
Control,	Heavy growth.

Same with B. diphtheriae.

1-50	No growth.
1-100	" "

Series B and C, 15 trials.

The same place used as in the preceding. Alcohol burned, 6 litres. Temperature, 14 degrees. Bacteria, B. tuberculosis, B. diphtheriae, B. anthracis. Time, 2—9 hours.

Observations upon the cultures:

		2 days.	10 days.	15 days.
B. anthracis,	6 trials,	Sterile.	Sterile.	Sterile.
B. tuberculosis,	4 trials,	"	2 not ster.	2 not ster.
B. diphtheriae,	5 trials,	"	1 " "	1 " "

Four animals were inoculated, 3 with cultures of anthrax, one with saliva bacteria. One inoculated with anthrax died but the bacillus was not found in the blood.

Series D, 12 trials.

Alcohol burned, six and one-half litres. Temperature, 15° C. Time, 6—9 hours.

		2 days.	10 days.	15 days.
B. anthracis,	4 trials,	Sterile.	Sterile.	1 not sterile.
B. tuberculosis,	4 trials,	"	"	Sterile.
B. diphtheriae,	4 trials,	1 lightly.	1 not ster.	2 not sterile.

Four inoculations were made 20 days after. One of the animals inoculated with the culture of diphtheria died of septicemia. The inoculation from the blood did not give diphtheria, but septicemia. The animals inoculated with the other cultures lived.

Series E, 12 trials.

Same arrangement as before. Alcohol burned, 7 litres. Temperature, 14° C. Time of exposure, 7—9 hours.

Observations upon cultures:

		2 days.	10 days.	15 days.
B. anthracis,	4 trials,	Sterile.	Sterile.	Sterile.
B. tuberculosis,	4 trials,	"	2 lightly tur.	2 turbid.
B. diphtheriae,	4 trials,	"	1 " "	2 "

Six inoculations tried upon animals; none infected.

Series F, 16 trials.

These experiments were made with all the rooms open, upon the lower floor. Alcohol burned, 5 litres. Temperature, 12° C. Size of place, 270 cu. metres. Time, 3—9 hours.

Observations upon cultures:

		2 days.	10 days.	15 days.
B. anthracis,	4 trials,	Sterile.	Sterile.	Sterile.
B. diphtheriae,	4 trials,	"	1 lightly tur.	2 tur.
Stap. py. aureus,	4 trials,	1 lightly.	1 lightly "	2 tur.
B. tuberculosis,	4 trials,	Sterile.	Sterile.	Sterile.

Animals inoculated all lived.

Series G, 12 trials.

These were made to find what kind of objects would retard the influence of the gas. Different things were used soaked in the cultures of the various germs; paper, wood, and cloth. These were placed in different parts of the rooms at greater or less distance from the lamp. Alcohol burned, 6 litres. Temperature, 16° C. Size of place, 210 cu. metres. Time, 3—9 hours. Four cultures each of Bacillus anthracis, diphtheriae, tuberculosis, and Stap. py. aureus were made upon the wood, paper, and cloth. After 20 days' observation, those in wood were all found sterile; the paper and cloth of the 8 tests gave six sterile, and 2 infected.

Experiments were also tried to see if the gas had any injurious effects upon different articles of furniture and other house furnishings. Eight litres of alcohol were burned in a room and the paintings, hangings, silver and other articles examined were found to be uninjured.

In conclusion M. Trillat sums up his experiments. The time of exposure of the germs to the gas has been from 2—9 hours; alcohol burned, from 5—8 litres. There have been 170 proof cultures made, and 35 inoculations. Of the cultures, 100 have been more or less turbid after 5 days. None of the inoculations have been followed by bad symptoms. The animals were inoculated from the turbid cultures, and so it is fair to suppose that all the pathogenic bacteria had been killed. The rooms should be closed without extra precautions; the lamp should be placed as low as possible; 2—3 litres should be used for each 100 cu. metres. The room should be as dry as possible, as moisture has a bad effect upon the vapor.

TESTS IN THE LABORATORY AT BOWDOIN COLLEGE.

The experiments made here at the Bowdoin chemical laboratory extend over some months. While a suitable lamp for the oxidation was being made, some work was done with the solutions upon different cultures of bacteria, to test their relative value as disinfectants.

Twelve cultures each of B. typhi abdominalis and Stap. pyogenes aureus were made in agar agar and incubated at 35° C. for 11 hours. Three drops of formalin of the following dilutions were dropped into each tube and then all placed in the incubator.

1-500 " "
1-1000 " "
1-2000 " "
1 control, Heavy-growth

Sterilized silk threads were soaked in bouillon cultures of typhoid. When dried, these were placed in a 1-100 solution of formalin. Single threads were removed every ten minutes, soaked in sterile water for ten minutes to remove excess of formalin, and then put into sterile bouillon.

	1 day.	2 days.	5 days.	19 days.
10 min.	Turbid.	Turbid.	Turbid.	Turbid.
20 min.	"	"	"	"
30 "	Clear.	"	"	"
40 "	"	"	"	"
50 "	"	"	"	"
60 "	"	Clear.	"	"
70 "	"	"	Clear.	Clear.
80 "	"	"	"	"

Same with threads soaked in B. coli communis.

	1 day.	2 days.	5 days.	19 days.
10 min.	Turbid.	Turbid.	Turbid.	Turbid.
20 "	"	"	"	"
30 "	Clear.	"	"	"
40 "	"	"	"	"
50 "	"	"	"	"
60 "	"	Clear.	"	"
70 "	"	"	Clear.	Clear.
80 "	"	"	"	"

A new generator was made which burns one litre of alcohol per hour. Experiments were begun in a room 30x10x13 feet.

All the dirty cloths and garments in use about the laboratory were collected, also a pillow and several cushions. Slips of filter paper were soaked in bouillon cultures of typhoid and wrapped in the different articles; some were also placed in books. The lamp was set at work with 2 1-4 litres of alcohol. After three hours and a half, cultures were made of the slips, in bouillon. Pieces were cut from the different articles for cultures. These were incubated for two days at 37 degrees, together with control cultures made before exposure to the gas. Those slips enclosed in books gave turbidity, also one slip wrapped in a pillow. Another, taken from the same place, was sterile: Those slips wrapped in cushions, in pockets, one in a drawer and one buried half an inch in sand, all gave clear cultures. Pieces cut from different garments,—coats, aprons, dirty towels, dust cloths, and an old burlap sack,—were sterile. The controls made before exposure to the disinfectant gave great turbidity.

One litre of alcohol was tried in the next experiment. Another set of cloths, garments, and cultures of typhoid were placed in the room. An exposure of four and one-half hours was made. Cultures were prepared as before. But few of the articles were found sterile. Those nearest the lamp gave clear cultures, but those farther away, turbidness.

Cloths were collected from the dissecting room, most of them very foul. These were placed in different parts of the room, some upon the floor, others hanging higher up, some near the lamp, others farther away. Two litres of alcohol were burned. The room was opened after five hours and cultures made from pieces of the cloths and incubated. Of the 14 cultures, 12 were sterile, two gave slight turbidness. One of the two was from a cloth near the lamp, another culture from the same piece was sterile.

In the next trial a mattress, quilts, and pillows were used. In these were inclosed slips of filtre paper soaked in typhoid cultures. But one litre of alcohol was burned. After 7 hours, test

cultures were made. Of the 12 cultures, 6 were sterile, and 6 gave turbidness. The sterile cultures were taken, 3 from the pillow, 2 from the quilt and one from the mattress. In these trials and in the following ones, the mattress was folded and the cultures were placed between the folds, making it necessary for the gas to pass through the whole thickness of the mattress. The quilt was folded several times and the pillows doubled and fastened together. The following day the same arrangements were made with the same articles. Fresh slips infected with typhoid were used and 2 litres of alcohol burned. After 7 hours exposure, cultures were taken and incubated. Every one was found to be sterile, 3 slips from the mattress, 4 from the quilt, and 4 from the pillow.

A regular bed was made up with double mattress, covers, and pillows and slips infected with Stap. pyogenes aureus were put between the mattresses under the quilts and pillows. A 12-hour exposure was made and 2 litres of alcohol were burned. After 2 days of incubation the test bouillon was found sterile in every case.

These experiments were repeated with germs of diphtheria and almost identical results were obtained.

The lamp was taken into a large room 60'x30'x15' to see if it would produce any effect in so large a place. Two trials were made with 2 litres of alcohol. In both cases about one-third of the cultures made from the slips were clear. For germs, Stap. pyogenes aureus and B. diphtheriae were used.

Two lamps were then tried, one in each end of the room. Each burned one litre of alcohol. This showed a gain over the other 2 trials. Out of 12 tests, 5 were clear; 7, turbid.

A few comparison tests were made to ascertain whether the solutions of the aldehyde could be profitably used for disinfection.

In the small room where the gas experiments were tried these were carried on and under the same conditions.

One hundred cu. centimetres of the formic aldehyde solution was poured upon a large piece of cotton cloth and spread upon the floor. Diphtheria and pyogenes aureus were exposed

directly to the fumes in different parts of the room. Time, 9 hours. Of the test cultures taken, 3 were clear and 5 turbid.

In the second trial, 3 were clear, 3 turbid.

Two hundred cu. centimetres were evaporated over a lamp. The bed was made up with the slips between the covers and some on top. Time, 11 hours. Those on top were sterile; the others were not. In evaporating over a flame a large amount of the aldehyde is changed into the solid form and wasted.

Experiments were tried with the solutions upon the disinfection of books. The following is an abstract from M. Miquel upon that subject.

Enough sodium or calcium chloride was added to the formalin to bring it up to 1,200 sp. grav. (one part salt to two parts of aldehyde). Cloth in rolls was dipped into the solution, unrolled and fastened to the edge of a box under the books turned upon edge. An exposure of from 24 to 48 hours in a box or cupboard of one to two metres capacity required from 70-80 grammes of the solution for sterilization. The addition of the salt makes more active the active parts of the aldehyde which do not evaporate as quickly as the water and are left as a white powder. This powder is not trioxymethylene, but rather a paraldehyde or aldehydes in different stages of polymerisation.

In our trials we put diphtheria cultures between sterilized blotters in books. Some were set upon edge, others placed flat in a drying oven of 1,089 cu. in. capacity. A cloth was placed beneath saturated with 15 c. c. of formalin. After six and one-half hours none of the cultures were sterile.

Second trial. Same as before, with 25 c. c. of formalin. Time, 19 hours. After 3 days incubation of the cultures, those taken from the books upon edge were found, 3 sterile, one very much retarded, and one very turbid. Of those from the books upon the side, 2 sterile, 2 turbid.

Third trial. Same with 50 c. c. of formalin. After 24 hours exposure and 3 days incubation, those books upon edge were sterile, those upon side, not sterile.

Fourth trial. The books were put in with typhoid germs upon threads. As the cloth was wet with formalin, did not add more. Exposed 48 hours. Those upon edge sterile, those flat not sterile.

In the experiments with the gas, some of the cultures were found to give turbidness after several days. In most of these cases a white film formed upon the surface of the liquid while the bouillon remained clear below. Plate cultures were made from these. Some were found to be mould growths; but most of them were due to the B. subtilis. This germ is spore forming and very hard to destroy. It is found in the air and very abundantly in infusions of hay. In fact, pure culture can sometimes be obtained by boiling such an infusion until all the other germs are destroyed. This germ is entirely harmless. In no trial were pathological germs found to have survived.

To further prove this, experiments were made in which care was taken that there should be no contamination of the pure pathogenic cultures exposed. The slips were all carefully sterilized before infection, and then placed between sterilized filter papers. The germ used was the pyogenes aureus which appears to be one of the hardest to destroy. These slips were placed in the mattress and pillows as before, and in each trial 2 litres of alcohol were burned. Every one of the cultures were clear after 2 weeks at a temperature from 20-38 degrees centigrade.

It was very important to find out what would be the action of the gas in general disinfection upon the pathological germs, as they would be found naturally in infected rooms, bedding, etc. With diphtheritic patients, the greatest source of contamination is in the sputum which is thrown out upon the bedding and dries there. Sputum from a patient suffering from the disease was spread out in several petri dishes upon bits of paper and threads. In some places the sputum was to the depth of a sixteenth of an inch or more. These were placed in a room of 1,400 cu. ft. capacity and 400 c. c. of alcohol used. After several hours the bits of paper were collected and twelve cultures made and incubated. Of the twelve, eleven were sterile

and one gave slight turbidness. As is seen, the amount of alcohol used in this experiment per cu. ft. was only about half as much as in the other trials.

At this time, fortunately, an opportunity was given to test the practical use of the gas upon a large scale. We were asked to disinfect a house in Portland, Me., where there had been three cases of diphtheria, one fatal. The house was a large brick residence very well furnished, and most of the furniture in place. The different patients had been ill in different parts of the house, so that the whole place must have been more or less infected. The whole house, including the three floors and basement, was of about 68,000 cu. ft. capacity. Two halls and stairs connected the three upper floors making two direct passages from top to bottom. The temperature was kept at about 70° F throughout the work. All the fireplaces were stopped with burlap or paper, but no other precautions were taken. Three generators were used, one of one quart, and two of two quarts capacity.

All three were placed in the basement, and that and the laundry first flooded with the gas. The generators were left near the doors. After the alcohol had evaporated, they were quickly removed and the doors were kept closed for at least 4 hours.

The rooms were all taken separately in this way throughout the house, one floor at a time, beginning with the basement. The generators were then placed in the halls, all the room doors being closed. The mattresses were left for the most part upon the beds. The closets and bureau drawers were opened, and the bric-a-brac, books, and other things left as they were with a good chance for the gas to circulate about them. It took about twelve hours to go over the whole house and nine gallons of alcohol were used or about one quart to every 2,000 cu. ft. of space. Threads infected with diphtheria cultures were placed around in different parts of the worst rooms between sterilized blotters. Of the twelve cultures made from these, every one was sterile after incubation.

There can be no doubt that formaldehyde gas possesses the greatest of disinfecting properties. It has great possibilities of

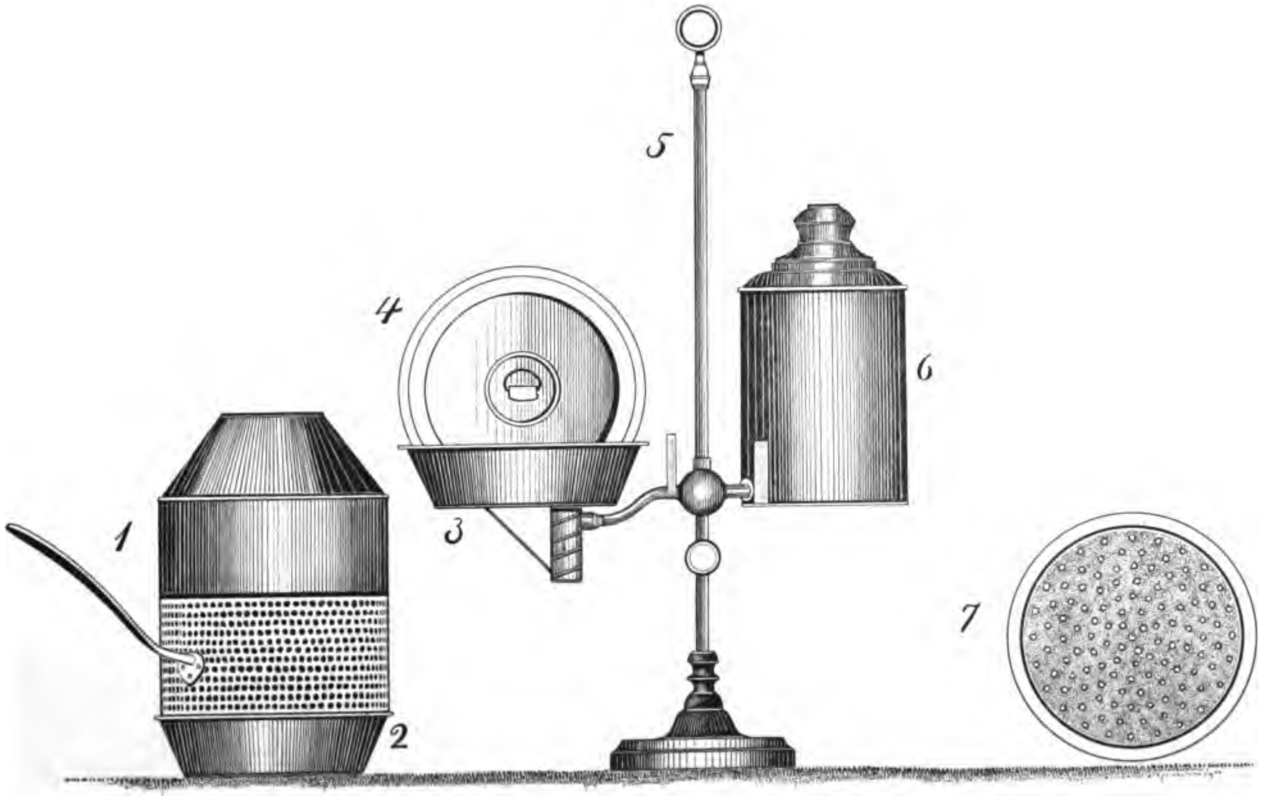
becoming a popular disinfecting agent. It has advantages above anything now in use for that purpose. It is comparatively cheap and with the new generator can be easily used by anyone of ordinary intelligence. It is not injurious to anything found in the most luxuriously furnished apartments. It leaves no disagreeable odors. If the windows are thrown open, in a short time no trace of the gas remains. In our experiments, all pathogenic germs were destroyed in three hours. But where the room is not needed for immediate use it would be well to leave it closed for 24 hours to make doubly certain under all conditions. The best and surest results are obtained with the rooms at ordinary living temperatures. Dampness is a disadvantage, as it absorbs more or less of the gas and holds the odor in the rooms. It can have no injurious effects upon persons occupying the house after disinfection, and the only inconvenience to those using the gas is a little smarting of the mucous membranes of the eyes and nose which can be avoided by the use of a damp towel. Bedding should be hung upon lines or chairs and everything exposed as freely as possible to the action of the gas. At least one litre of alcohol should be used for every 2,000 cu. ft. of space, which would be about a quart for a room 15'x13'x10'. With a little care and common sense, good results can be obtained.

Explanation of Figure.—1—2—A shell of sheet metal partly perforated, with a handle attached. It is about seven inches in diameter. At about the top of the perforated part is a support on which the disc 7 rests. This disc is made of asbestos about 1-8 inch thick, and is perforated with about one hundred 1-8 inch holes, and platinized.

4—A common cover which fits closely on the pan 3.

6—A tank similar to that on a student lamp with an inner part so that liquid put into it flows out into the pan 3 forming a layer about one-half inch in depth.

In operating the generator after filling the tank with the wood alcohol, the shell is seized by its handle, the alcohol in the pan lighted, the shell placed over it, and allowed to remain about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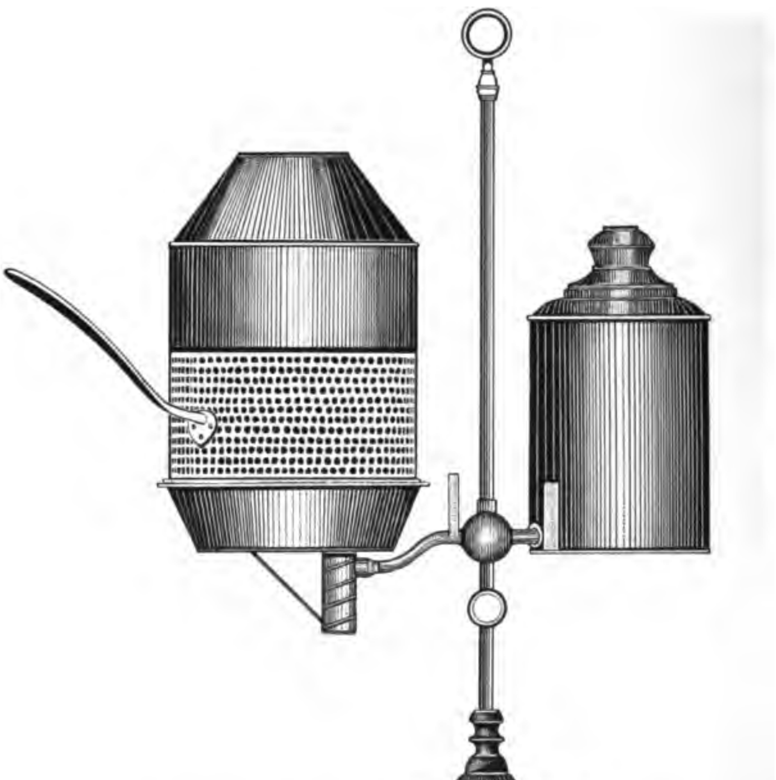

fifteen seconds. It is then removed and the flame of burning alcohol extinguished by putting on the cover for a moment. The cover is then quickly removed and the shell replaced. The fumes of warm alcohol and air coming in contact with the platinized asbestos are changed to formaldehyde, and the disc grows red hot and remains so as long as there is alcohol in the pan.

Experiments show that a low red heat is best, but in an open room where currents of cold air may come in contact with it, it is somewhat difficult to maintain this temperature without cooling it too much, hence it is best to set it into a box while in action. It has been found convenient to have a case and to make use of this for the box.*

The generator may be started up by first setting the shell over a little burning wood alcohol in a common saucer instead of the way given. This avoids lighting the alcohol in the pan which some may think objectionable.

FRANKLIN C. ROBINSON.

Searls' Chemical Laboratory, November 16, 1896.

* The generator has since been modified so as to continue in operation without this protection.

THE PRESENT STATUS OF THE ANTITOXIN TREATMENT OF DIPHTHERIA.

By CHAS. D. SMITH, M. D.,

President of the Board, Physician to the Maine General Hospital, Professor of Physiology, Bowdoin College.

Diphtheria and its management still occupy the leading place in the attention of sanitary authorities, as well as in that of the medical profession, and the question of control and prevention has lost none of its interest, notwithstanding the accumulation of facts which have simplified a problem which three years ago seemed so obscure.

In another part of this volume appear copies of articles treating of this same subject, which have from time to time been issued by this Board for public information, and this paper is presented, although necessarily involving some repetition, as a part of the same policy which aims to keep the people of this State fully informed upon the subject of infectious diseases and the latest and best methods of limiting their extension and accomplishing their cure.

Antitoxin continues to stand as the chief remedial agent which successfully opposes the infection of diphtheria, and since its presentation to the scientific world at Buda Pest by Dr. Roux, in September, 1894, evidence of its efficiency has so steadily accumulated, and to such an amount, that we are warranted in accepting the statement that to-day it is the one remedy of greatest value in the treatment of diphtheria.

The advance of opinion toward this conclusion has not been precipitate: Such claims as were put forth in the interest of

antitoxin were not new to the medical profession, and skepticism on its part was not unnatural nor unexpected: this method of administration of a curative agent was novel to the laity: the high price asked for the seemingly small amount of the remedy has been somewhat of an obstacle to extensive use in private practice, and a vigorous controversy over its utility has been carried on by gentlemen having exceptional opportunities of observation in our largest medical center: all these facts have operated to influence many to delay use of the serum, in a state of mind neither receptive nor repellent: conservatism marked its reception and has attended its progress. All these factors have tended to produce reliable information of its nature and thereapeutic results.

At the time of its introduction it was expected and desired that the reports of its utility would be examined with the most careful scrutiny, and its most confident advocates frankly stated that not until statistics could be gathered from a large number of observers and from a vast number of cases covering a considerable period of time, could any predictions be made with reference to its permanency as a reliable remedial agent.

As time has passed, statistics have accumulated from the best of sources; methods of production have been simplified and perfected; most accurate tests have been applied to determine its potency for good, and its possibilities for harm; and the weight of evidence is now more than ever in its favor, as the best and most trustworthy agent at our command, for the treatment of this disease.

It is the purpose of this paper to present something bearing upon different phases of the antitoxin treatment; its results; the influence of the serum as a preventive agent; its harmlessness; its strength; the technique of its administration; and in so doing to offer the reasons for the above conclusion as to its usefulness.

The Effect of Antitoxin as a Curative Agent.—It is difficult to do more than approximate to correct estimates from figures, because so many dverise influences must be considered. Since the systematic employment of bacterial culture methods in diag-

nosis, errors attributable to doubtful and wrongly diagnosed cases have been reduced to a minimum, so that present statistical returns have a more accurate basis.

It should be borne in mind that most of our figures have been taken from the reports of hospital cases which usually average more severe, with a correspondingly higher mortality ratio, than cases in private practice. For this reason it has been possible to receive these reports with a reasonable conviction of their accuracy. Hospital reports have been criticised as including many doubtful cases, designated as diphtheria by the employment of culture diagnosis, which has been allowed to overshadow clinical evidence, which evidence, under other circumstances, would have been accepted as conclusive of a non-infectious disease, thus lowering the death-rate by raising the total number of cases. We may admit a certain amount of error from this cause, and concede as well that the mere presence of the Klebs-Loeffler bacillus does not necessarily mean a case of diphtheria. We may limit the cases to those proven to be such by both bacterial diagnosis and clinical features, exclude absolutely all doubtful cases, admit everything which the critics of hospital statistics claim may be yielded, and one plain stubborn fact will remain, and that is, that since the use of antitoxin was begun there has been a remarkable fall in the death-rate of diphtheria as compared with that which obtained before antitoxin was known. This difference is too great to be a coincidence: it is too constant to be explained by chance, nor can the plea of a milder prevailing type of disease be urged, without being refuted by the testimony of hospital records, health authorities, and medical societies the world over. Evidence is distinctly to the effect that the type has not varied; indeed, if one may judge of the comparatively large number of cases requiring operative interference to relieve obstructed breathing, it has been inclined toward severity rather than the reverse.

In August, 1895, Dr. Wm. H. Welch of Johns Hopkins University, published statistics of results which were tabulated from the observations of eighty-two authorities in hospitals in Germany, France, Austria, Belgium, Switzerland, England and America, indicating a reduction of the death-rate by at

least 50 per cent. since the introduction and use of this agent. These statistics are here recalled, because they were in the highest degree confirmatory of the early claims made for the curative power of the serum, and because they have received the most abundant confirmation by those which have since been secured, not only from hospital wards, but from private practice, as well.

Without attempting to quote a formidable list of figures, one may be allowed to instance a few as indicative of the general trend.

Twelve American cities show an average death-rate *since* the introduction of antitoxin of 10.45 per cent., as compared with 44.54 per cent. prior to that date, for equal lengths of time.

Eight European cities give a percentage of 14.04, against one of 52.19 during the pre-antitoxin period.

In all these places were large public hospital services, and the number of injections was more than a million. But, say some, these are figures from antitoxin advocates; granted, but in the face of an array of facts and figures now overwhelming, and in view of the fact that those who have had the largest experience with antitoxin are the most earnest advocates of its use, it would seem as though the burden of proof to show whence, if not from antitoxin, has come the lowered death-rate, had been thrown upon the doubters.

Dr. John H. McCollum, Resident Physician at the South Department of the Boston City Hospital, in a paper read before the Massachusetts Medical Society, in June, 1896, gives some figures which tell a plain story.

"Table of the number of cases of diphtheria treated at the Boston City Hospital, with the deaths by ages from September 1, 1895, to May 1, 1896:

Ages.	Cases.	Deaths.
1 year	17	3
1—2 years	74	20
2—3 "	136	37
3—5 "	329	55
5—10 "	410	39
10—20 "	187	9
20 years and upwards	206	7

Cases in which antitoxin was used, 1359, with 170 deaths; per cent., 12.50. Cases from February, 1891, to February, 1894, in which antitoxin was not used, 1,062, with 493 deaths; per cent., 46."

Apart from its application to his own work and its results, his expression that "certainly a diminution of the death-rate from 46 per cent. when antitoxin was not used, to one of 12.50, when it was used, can only be explained by the remedial power of this agent," may be accepted as sound reasoning and justifies the conclusion that the claims made for antitoxin in 1894 have been amply verified.

From the report of the London Metropolitan Asylums Board on the results from the use of antitoxin, it is shown that there occurred during the year 1895 (under the use of antitoxin), in six hospitals, 3529 cases of diphtheria, of which 22.5 per cent. were fatal.

From the recods of the Kaiser and Kaiserin Friedrich Children's Hospital in Berlin, Dr. Adolph Baginsky gives the following figures as a specimen of the results of the present method of treatment with serum with which former results can be easily compared:

1896.	Number cured.	Died.	Per cent.
January	27	2	6.89
February	25	4	16.00
March	25	3	10.71
April	25	0	0.00
May	25	3	10.71
June	20	1	5.00

Total death-rate for 160 cases during six months, 8.12 per cent.

These percentages, he says, are to be placed against former percentages of from 40 to 50.

No more stricking testimony has been introduced than that early offered by Professor Virchow, when in December, 1894, at a meeting of the Berlin Medical Society, he commented upon the results of the treatment of diphtheria in Hospital from March to December, part of the time with, and part of the time without

antitoxin, the latter experience involuntary experiment due to the failure of the supply of serum. Himself a doubter in the efficacy of the serum treatment, and questioning the scientific explanation of its probable action, he yet confessed himself obliged to admit the force of the figures.

During the use of antitoxin, the mortality fell to 12.5 per cent.: when the supply stopped, it rose to 50.43 per cent.

From March to December the total death-rate with serum was 13.2 per cent.; without serum, 47.8 per cent. The total number treated with antitoxin was 303; treated without this agent, 230. All the cases occurred in the same hospital and all were proven to be genuine diphtheria.

At the annual meeting of the Maine Medical Association in June, 1896, Dr. A. G. Young, Secretary of this Board, presented some facts derived from the reports of the Imperial Board of Health of Germany, which are here introduced to show how closely reports from different sources correspond. The remarkable similarity of the results of observation from all over the world cannot possibly be due to collusion between the advocates of antitoxin, and the suggestion of coincidence is too improbable to be for a moment entertained.

"The Imperial Board of Health of Germany has been publishing the results of its collective investigation relating to the use of diphtheria antitoxin in that country. For the first three months of 1895, reports were received of 2228 cases of diphtheria treated with antitoxin, with a mortality of 17.3 per cent. For the second quarter, 2130 cases were reported, with 14.3 per cent. of fatal cases. For the first half of the year, there was a total of 4358 cases. Of these, 672 died. The percentage of deaths among these 4358 cases was, therefore, only 15.4. This may be accepted as a remarkable success in view of the fact that the usual mortality in German hospitals has been about 50 per cent., and of the additional fact that this series and this rate of mortality includes all the hopeless cases and those in which death occurred within twelve hours.

"Answering the question whether this favorable showing was due to a preponderance of mild cases, it is stated that, of these 4358 cases, there were:

1459 mild cases	33.5	per cent.
629 cases of medium severity	14.4	" "
2097 severe cases	48.1	" "
173 not stated	4.0	" "

"Strongly confirmatory of the truth of the statement that the prevailing type of the disease was not that of mild diphtheria, is the fact that 1220 of the cases, or 28 per cent. of them, required tracheotomy or intubation.

"One thing about the antitoxin reports which is gratifying is that, generally, the later series of cases reported from the same sources give progressively better results. For instance, Baginsky's former series of 525 cases had a mortality of 15.6 per cent., while late last year he gave another series of 224 cases with a percentage of only 9.3 fatal cases." (See Baginsky's latest series, page 197.)

It has already been stated that most, if not all, statistics of value have hitherto been derived from hospital wards, where, if it be true that the cases are usually severe in type, it must also be admitted the facilities for prompt, thorough and systematic treatment are far superior to those of private practice. There has been lacking, until recently, any trustworthy information from private sources, which, if reliable, would prove of the greatest value in supplementing the reports from institutions and would essentially modify the *ex parte* character of statistics already tabulated, and contribute still more to the elimination of error. This kind of information has been afforded, as the result of a systematic plan of inquiry made by a competent committee of the American Paediatric Society, a medical organization devoted to the study and treatment of diseases of children.

The facts upon which this committee has reported, have been drawn wholly from private practice, and are embodied in the first report made to the Society at its Eighth Annual Session in Montreal, May 26, 1896.

The report of the committee is entitled, "The Collective Investigation Report upon the Use of Antitoxin in the Treatment of Diphtheria in Private Practice." This is presented under two heads: first the general results, and second, the results in operative cases.

General results: There were examined reports from 3384 cases occurring in the practice of 613 physicians from 114 cities and towns in 15 different states, the District of Columbia, and the Dominion of Canada; and, in addition, from 942 cases treated in their homes in the tenement-house districts of New York, and from 1468 cases in similar sections of Chicago.

"The general mortality in the 5794 cases reported was 12.3 per cent.; excluding the cases moribund at the time of injection, or dying within twenty-four hours, it was 8.8 per cent. This rate of 12.3 per cent., taking the higher, corresponds very closely with the average of the great public institutions." To these figures may be added one series of 225 cases, reported in April, 1895, by Dr. Louis Fischer of New York City, in which he gives a mortality rate of 15.1-9 per cent., and since that time, another series of one hundred cases of 7 per cent., septic and moribund cases included.

The very latest information upon the results of the antitoxin treatment, are, at the time of this writing, being given to the public through the columns of The Medical News by Dr. Biggs, the Director of the Laboratories of the New York Health Department, and his assistant, Dr. Guerard.

Their figures are compiled up to October 1, 1896, and are confirmatory of those given above from other sources. Without giving the tables the conclusions are here stated.

1—From table of cases treated under the direction of the Health Department:

From January 1, 1895, to October 1, 1896, the total number of cases was 1,252; the number of deaths was 198, a mortality rate of 15.8 per cent. Deducting cases moribund at time of injection, or dying within twenty-four hours, the rate is 10 per cent. All fatal cases are included, no matter what the complications (exclusive of laryngeal cases), which contributed to or determined the cause of death.

2—From table of cases treated by physicians with free antitoxin from October 1, 1895, to October 1, 1896:

Total number of cases, 375; deaths, 68; mortality rate, 18.1 per cent.; deducting twenty-one moribund, or dying within twenty-four hours, the rate is 13.2.

Of the entire number of cases reported, thirty-four were excluded because of imperfect data or because proved non-diphtheritic by culture.

In this total of 375 cases, 307 received one injection; 65, two injections; and 1 received three, and 1 four.

A private letter to the writer from a gentleman connected with the Health Department of New York City, December 20, 1896, gives the following facts relative to changes in mortality rate in that city since the beginning of the antitoxin treatment, compared with two years previous. It evidently includes all cases known.

Year.	Cases.	Deaths.	Case Fatality.
BEFORE USE OF ANTITOXIN.			
1893	7,021	2,558	36.7 per cent.
1894	9,641	2,870	29.7 " "
USE OF ANTITOXIN COMMENCED.			
1895	10,353	1,976	19.1 per cent.
1896	8,286	1,392	16.8 " "

(First three-quarters of year.)

"The drop in mortality rate in 1894, without use of antitoxin, is attributed to the introduction of culture diagnosis with its consequent more complete reporting of cases. The drop from 29.7 per cent. to 19 and 16 is attributed to the influence of antitoxin.

"About two-thirds of the fatal cases as determined by investigation, never received any antitoxin; many of the remaining one-third only received it late in the disease.

"The mortality at the Willard Parker Hospital shows a reduction from 34 per cent. to 23 per cent."

The writer's informant expresses his opinion, which coincides with that of other competent observers, that antitoxin administered early will save over 50 per cent. of cases which otherwise terminate fatally.

Advice to this Board from the Health Department of Boston, under date of December 21, 1896, says:

"In the use of this agent, the percentage of deaths in the City Hospital, where we have the worst cases, is about 13, and outside of the hospital, where antitoxin is used, a trifle over 9."

To these facts may be added the summary of reports from Paris and Berlin covering a period from 1880 to July, 1896.

PARIS.

	Antitoxin not used.	Antitoxin in general use.
Largest number of deaths for any month......	219	73
Smallest " " "	58	14

BERLIN.

Largest number of deaths for any month......	193	119
Smallest " " "	49	27

(Dr. H. M. Biggs, Medical News, Dec. 12-19, 1896.

Of even greater significance are figures compiled from reports of that class of diphtheria cases in which, by reason of obstruction in the respiratory passages, operative interference becomes necessary. These cases always influence most strongly the mortality rate.

The London Metropolitan Asylums Board, gives the following mortality rates in cases operated upon by tracheotomy, accompanied by the use of antitoxin in 1895, as 49.4 per cent., against 70.4 per cent. in 1894 without antitoxin.

Dr. McCollum in the paper already quoted (page ..) emphasizes the relief given in cases of laryngeal obstruction by the administration of the serum, in cases *without* operation, in which, before antitoxin was known, only an operation would have been thought to offer any hope.

He says further, "In the operation cases the relief in many instances has been very marked. In the Boston City Hospital for the year ending January 31, 1895, there were 89 intubations and 74 deaths, a percentage of 83. In the South Department of the Boston City Hospital for eight months there were 136 intubations and 63 deaths, giving a percentage of 46, a diminution of 37, nearly one-half."

Out of the 3,384 cases analyzed by the Paediatric Society's committee, the larynx was affected in 1,256 cases, or 37.5 per cent.

In 563 cases, recovery took place without operation. In many of these cases, the symptoms of stenosis were severe and yet disappeared after injection, *without* intubation. In establishing the value of the serum, nothing has been so convincing as the ability of antitoxin, properly administered, to check the rapid spreading of membrane downward in the respiratory tract, as is attested by the observation of more than 350 physicians who have sent in reports. Operations were made in 565 cases, 16.7 per cent. of the entire number reported.

Intubation was performed 533 times, with 138 deaths, or, a mortality of 25.9 per cent.

In 32 cases only was tracheotomy done, with 7 deaths, a mortality of 37.4 per cent.

Of the 565 operative cases, 66 were either moribund at the time of operation, or died within twenty-four hours after injection: if these be deducted, the total mortality from 499 cases would be 16.9 per cent.

The total mortality of all non-operative cases was 9.12 per cent. A comparison of the results of intubated cases in which serum was used was made with those secured before antitoxin was introduced. The best mortality rate in 1895, in 5,542 cases was 69.5 per cent.; since then 51.6 per cent. Against these are contrasted 533 intubations *with* antitoxin with 25.9 per cent. mortality.

With the 279 cases giving a mortality of 51.6 per cent., are to be placed 280 cases reported to the committee by fourteen observers, with a mortality of 23.2 per cent.

What the committee further says is so apparent and so convincing that it is here quoted entire:

"In both these comparisons (those just given above), the mortality *without* the serum is more than twice as great as in the cases in which serum was used.

"The reports of some individual observers concerning intubation *with* the serum are interesting.

"Neff, New York, 27 operations, 27 recoveries.

"Rosenthal, Philadelphia, 18 operations, 16 recoveries.

"Booker, Baltimore, 17 operations, with 17 recoveries including one patient aged ten months, and one seven and a half months.

"Seward, New York, 8 operations, with 8 recoveries.

"McNaughton, Brooklyn, 'In my last 72 operations *without serum*, mortality 66.6 per cent.; in my first 72 operations with serum, mortality 33.3 per cent.'

"O'Dwyer, New York, 'In my last 100 intubations, first 70 without serum, mortality 73 per cent., last 30, with serum, 33.3 per cent.'

"But even these figures do not adequately express the benefit of antitoxin in laryngeal cases. Witness the fact that over one half the laryngeal cases did not require operation at all. Formerly 10 per cent. of recoveries was the record for laryngeal cases not operated upon. Surely, if it does nothing else, the serum saves at least double the number of cases of laryngeal diphtheria that has been saved by any other method of treatment."

This, the committee states in its summing up, it considers the most convincing argument, and an absolutely unanswerable one, in favor of serum therapy.

The committee proposes to carry on still further investigation of the serum treatment in laryngeal cases and has extended to the profession at large an invitation to coöperate.

So far, therefore, as we may believe authentic reports there can be but one interpretation of the effect of antitoxin properly administered, upon diphtheria in the majority of cases, and, at the present writing, the mortality under the serum treatment may be regarded as about 10 per cent. Only a few of the many tabulations easily accessible have been given here, but enough, it is believed, to establish at least a reason for its continued use. Those given are certainly most striking.

There is good evidence also that the use of the serum in operative cases has produced a material diminution in the duration of intubation, besides lowering the mortality and obviating

the necessity of resort to the more severe operation of tracheotomy. Rosenthal of Philadelphia has reported (May 21, 1896,) upon this point from the observations of a large number of American and foreign observers, a reduction of the period required to an average of 120 hours. Formerly it was six or eight days.

Immunizing Power.—Following the discussion of the potency of the serum to cure, naturally follows inquiry as to further facts bearing upon its early alleged power to secure immunity from attack to those exposed to contagion. Whether the failure of any individual to contract an infectious disease is due or not to particular substance administered for that purpose, is a point confessedly more difficult to demonstrate, than the direct agency of a substance to cure. Until we know more than we now do of the subtile vital processes which enable our tissue to resist infectious influences, we shall be obliged to content ourselves with probabilities. Much, however, has been accomplished in this direction and a brief statement may properly be included in this paper.

Opinions differ among authorities as to the probable duration of the protection afforded by preventive doses of antitoxin, it being variously estimated as from two to six weeks. An average of the different estimates is about four weeks.

That it possesses this power in some degree may be believed from the published experiences of numerous public institutions, the inmates of which have been freely exposed to the contagion of the disease before time had sufficed to make diagnoses, or secure isolation.

Dr. H. M. Biggs of the New York Health Board reports in the Medical News of November 30, 1895, the results of immunizing doses administered to 1,043 children in four large institutions, in the greater percentage of whom bacteriologic examination demonstrated the continued presence in the throat of the diphtheria bacillus and all of whom had been under exposure to the infection in greater or less degree, with the result, that, among this number, there occurred during the next thirty days, three cases; within the first twenty-four hours after

immunization, four. The number of cases that had occurred prior to immunization was 366.

In all these institutions the disease was prevailing in epidemic form, but after the commencement of immunization, the disease was quickly and completely eradicated.

There are later reports from one of the largest of these homes, collected since Dr. Biggs' report, which show that the results then observed have been amply confirmed by further proof, and that the theory of coincidence has been materially weakened. At the Nursery and Children's Hospital following the epidemic reported upon in 1895, no further cases appeared until October 26, 1895, a period of six months.

Then in one ward was discovered a single case. Prompt isolation followed, and the twenty-three remaining children were immediately given immunizing doses of antitoxin.

Although there had been undoubted exposure for several hours, not one of this number contracted the disease. Up to August, 1896, 380 children had received antitoxin, some of them a number of times, and the youngest was two weeks old. Eighty of the cases exhibited more or less nasal discharge in which the diphtheria bacillus was demonstrated, although from this number all immunized, not one developed any clinical signs of diphtheria. The reporter (Dr. A. M. Thomas) further says: "These continued good results from our use of antitoxin as an immunizing agent are surely most satisfactory and in full accord with last year's work and that simultaneously done elsewhere. No serious ill effects from its use have been obtained in any of the 326 cases. On the other hand, its positive value as a prophylactic agent is very pointedly evidenced from last year by the sudden cessation of our epidemic immediately after immunization was practiced, and in this year by our escape from the usual and for the past many years more or less severe and fatal epidemic of diphtheria in various wards of the hospital."

Dr. Thomas also reports a fact of great interest in this connection, that "in several instances in which mothers with true diphtheria refused to be separated from nursing infants or young children, they were permitted to keep the children with them

in the diphtheria ward during their entire illness, the children being immunized and carefully watched. *In no case* of this kind did the child develop diphtheria."

He gives the following tabulation of cases immunized from April, 1895, to August 21, 1896.

Age.	Previously reported.	Present report.	Total.
3 weeks to 3 months.............	19	58	77
3 months to 6 months............	36	45	81
6 months to 1 year...............	22	69	91
1 year to 4 years.................	59	154	213
	136	326	462

Tabulations of the results of immunization use of antitoxin by the inspectors of the New York Health Department from January 1, 1895, to October 1, 1896, give the following facts:

Total number of cases immunized, 1,207.

Number of antitoxin units injected, 50 to 500.

Number of cases of diphtheria within 30 days after injection,

1 on the 7th day.

1 on the 10th day.

5 on the 19th and 20th days.

1 on the 30th day.

1 severe on the 5th day.

1 on the 2nd day died of scarlet fever and diphtheria.

Number of cases of diphtheria within 24 hours and after 30 days after injection.

After 30 days,

2 mild recovered.

1 on 55th day died, within 24 hours.

7 mild pharyngeal.

5 croup, all recovered.

In other words, out of 1,207 exposed and immunized, 27 afterward developed diphtheria. Before immunization was practised, there were one or more cases in 395 families.

It must continue to be a matter of regret that the immunity period is so comparatively short. Perhaps this brevity

impresses us the more because our previous education in the advantages of protective inoculations has been derived from an experience with vaccine virus, the protection from which extends over a considerable period of time, and may be relied upon, at least to modify the virulence of variola, if it does not, as in the vast majority of cases it does, protect absolutely.

Serum therapy is, however, as yet only in the formative period of its existence, and it may be confidently predicted that time with its continued experimentation will demonstrate for it greater and assured possibilities for protection against a considerable number of infectious diseases.

Improvements in the Quality of Serum and Tests to Determine its Potency.—One of the first practical questions put to the advocates of the serum treatment by the medical profession called for definite information as to the inocuous character of the material and its power to neutralize the effect of the toxines of diphtheria. These facts, the bacteriologists, as well as the manufacturers of the serum, have labored earnestly to determine, with a fair measure of success. The best possible testimony as to the harmlessness of the serum, when injected into the human body is the fact that, notwithstanding the chance of sepsis from careless handling of the serum, from imperfectly sterilized syringes, the ignorance of strength of doseage, due to the variations in strength of the different samples placed upon the market, especially in the first months of its use, practically no harmful effects can be attributed to its use in the thousands upon thousands of cases in which it has been administered.

But five deaths have been attributed to the direct action of the serum or the carbolic acid which in some samples of the article is added for its preservative effect, and *not one* of these fatal cases upon rigid examination has been shown to be even remotely connected with the serum itself.

In the discussion upon this topic before the Maine Medical Association already alluded to (page 188), Dr. A. G. Young said, in speaking of the dangers of antitoxin, "if the considerable amount of statistical data now available shows anything, it shows that antitoxin is a comparatively safe remedy. Fatal-

ities and serious accidents attributable to the antitoxin have been very rare. This series of cases of the Imperial Board of Health of Germany, contained no cases in which death was referred to its use.

"Dr. Welch, of Johns Hopkins University, tabulated the results of the use of the antidiphtheritic serum in over 7,000 cases in which no fatality was due to the antitoxin. The experience and reports of other observers have been the same.

"The State Board of Health of Massachusetts prepares and distributes diphtheria antitoxin in its own state and is collecting information concerning the results. Over 2,500 inquiry blanks have been sent out. So far no death referable to antitoxin is known, but some untoward effects have been learned, due to a disobedience of the printed instructions with each phial not to use the antitoxin after it has been opened twenty-four hours. And, using the antitoxic serum so carelessly as some physicians do, and so utterly in disregard of antiseptic precautions, I have wondered that accidents have been so few as they have.

"Some physicians take no precautions to cleanse and disinfect the surface of the skin before puncturing it, fail to sterilize the syringe used in the administration of the antitoxin, use a common hypodermic syringe so small as to require several punctures in giving a single therapeutic dose, and even fail to expel the air from the cylinder of the syringe before making the injection.

"But with all this carelessness, the number of serious accidents referred to the use of the diphtheria antitoxin is very small.

"Two deaths at least, attributed to antitoxin, have been reported in France, neither of which closely followed the use of antitoxin. Roux's preparation was used in both cases. In one of the French cases four therapeutic doses of antitoxin had been given. Anuria followed each of the last three doses. In the other case convalescence was apparently progressing favorably, but death occurred about a weeek after the injection.

"One so-called antitoxin death, the Valentine case, occurred in Brooklyn, N. Y. I think that no satisfactory explanation of the cause has yet been given. (Later information attributes this death to the accidental entrance of air into the circulation.)

"In the last fatality credited to antitoxin, that of the twenty-one months' old child of Professor Langerhans, the sensational report of the case announced that, after the administration of antitoxin, the death was instantaneous. Referring to this case, Eulenberg says that not even the injection of serpent venom, and only the action of prussic acid could cause so sudden a death. Its cause by the antitoxic principle itself, or by the serum is out of the question. He is of the opinion that the death of the child could have been due to no other cause than embolism or the entrance of air into the vascular system."

A series of experiments has been conducted by Seibert and Schwyzer upon the effects of the injections of serum, carbolic acid or air into the circulation. The experiments were made upon guinea-pigs, first with antitoxin which was injected directly into the venous circulation, with no untoward result.

Next carbolic acid in dilute form was injected, causing more or less stupor, convulsions, symptoms of tetanus, followed by prolonged convalescence, and finally recovery.

In the third series of experiments, air was injected and death followed immediately or soon after.

These experimentors published their conclusions from these investigations as follows: (Medical Journal, May 30.)

1. Antitoxic serum does not seem to be capable of causing threatening symptoms and speedy death, even when brought quickly into the blood current in very large doses.

2. The carbolic acid used in preserving the antidiphtheritic serum must be in such a weak solution as to be entirely unable to cause the characteristic carbolic convulsions produced in every one of our second series of experiments. The absence of these convulsions in patients in the cases of sudden death, the entirely different group of symptoms reported in them, and the fact that guinea-pigs and rabbits will survive even very large and concentrated doses of carbolic acid injected into a vein, lead us to discard the possibility of this drug having caused the reported deaths.

3. Even very small quantities of air will cause severe disturbances and ultimate cessation of breathing in every animal

experimented upon. These disturbances are entirely analogous to the symptoms reported as preceding the sudden deaths after antitoxin injections. Air is found alongside of the fluid in every syringe used for hypodermic injections, and being pressed under the skin with the fluid may readily come in contact with a punctured cutaneous vein and so may enter the blood vessel and the right heart even before the serum has been absorbed.

In view of these facts and of our experiments we here express our firm opinion that the sudden deaths reported after antitoxin injections were caused by injected air and not by the antidiphtheritic serum.

From the first it has been apparent that there was a considerable variation in the strength of the different preparations and in the products of the same laboratories at different times, and the need of information with reference to doseage, at least approaching accuracy, has been eagerly sought, because under no other circumstances could positive results be assured.

In nothing connected with serum therapy have more painstaking efforts been expended, and all samples of serum are now put upon the market accompanied by positive statements as to the potency of each specimen. The system of doseage is, of course, based upon the proposition, that a definite amount of antitoxin strength is required to neutralize a definite amount of diphtheria poison or toxin. The strength of each specimen of antitoxin is expressed in units, and is worked out by a series of careful laboratory tests. The problem for the physician is to determine at the bedside the probable amount of poison which requires neutralizing and to adapt the number of his units, in other words his dose, accordingly.

These tests are not only interesting, but should be thoroughly understood by every one who administers antitoxin, if he would appreciate the therapeutic value of the remedy.

The strength of most serums is now expressed as has been said, by units, but the earlier method and one now applied to a few products, is to calculate the strength upon the relation of the amount of serum to the weight of the guinea-pig upon which the experiment was made, or the proportion of serum which

would protect so many grammes of animal against a fatal dose of toxin, and this is indicated by the formula 1 to 50,000, or 1 to 100,000, meaning the power to protect a bulk so many times the weight of the serum. For human dosage it became a matter of computation to determine the probable weight to be protected and the bulk of the serum necessary to accomplish it.

A method is now in vogue which expresses the strength by a statement of the number of units which each sample of serum contains, a normal serum being one of which 1-10 c.cm. neutralizes the power of ten lethal doses of diphtheria toxin, previously administered to a guinea-pig of known weight. This is the standard of Behring and Erlich and the one by which most of the serums are tested.

For example, the minimum fatal dose of toxin is found which will kill per 1,000 grammes weight of guinea-pig. Of this toxin ten times the amount required to kill an animal of from 200 to 300 grammes weight in less than forty-eight hours is injected, together with the antitoxin to be tested and the result awaited, noting the absence or presence of local reaction, and any loss or increase of weight. At the end of forty-eight hours if the toxin is completely neutralized the animal lives and shows no ill effects from the experiment.

Therefore a serum having one normal antitoxin unit per c.cm. is of such strength that 1-10 of a c.cm. successfully opposes the effect of ten fatal doses of toxin. Such a serum is called a normal serum. Hence in testing to determine whether any given sample of serum contains the number of units attributed to it, it is only necessary to find out first the fractional part of a c.cm. which is protective, and then divide it by 10. For example, if it is found that 1-1000 c.cm. protects, then each c.cm. will contain 100 units; if 1-2500 only was needed, then each c.cm. would contain 250 units.

The antitoxin unit may then be defined as the amount required to completely neutralize the action of ten lethal doses of the toxin, and that should be 1-10 c.cm.

A serum which is said to be 100 times normal strength, contains 100 units in each c.cm. If of 250 times normal, then there are 250 units in each c.cm.

It has always been apparent that great diversity must exist between the different antitoxins in use because of the variations in results under probably similar circumstances. Tests show that the products of the German laboratories, those of the health boards of some of our great cities, and those of our prominent pharmaceutical houses, maintain their guaranteed potency while some of the antitoxin from France and some produced in this country, have at times failed to show a correspondence between the statement of the labels and the results of the tests, being much weaker than the labels certified and requiring the administration of a considerable bulk of fluid to secure favorable results. Series of tests instituted in England by the London Lancet, and in this country by the Medical News to determine how closely trade samples approximated to their affirmed strength, correspond very closely in showing a marked difference in some samples between actual and advertised number of units, and the variation in samples from the same source already referred to.

The Lancet's investigation gives an exhaustive analysis of the products of ten laboratories in England, Germany, France, Belgium, and Switzerland, from which it appears that the requisite quantity necessary to inject to secure the action of the required number of units varied from 12 c.cm. to 300 c.cm., or from about three drams to nine ounces and three drams. The lowest quantity represents a sample of Behring's; the greater, one of English manufacture.

In the tests instituted by the Medical News, nineteen samples were examined by Professor A. C. Abbott, Professor of Hygiene of the University of Pennsylvania. All samples were obtained in open market, sent to the laboratory without labels, designated only by numbers, so that there was no possibility of bias on the part of the bacteriologist. Nineteen different samples were examined, three showed a deficiency in the requisite number of units to make them efficient. Four were of unusual strength,

and the balance up to the standard, or so near as to be practically so. Yet it is apparent, as the compiler of the results points out, that the real and advertised strength differ materially in many of them, though it does not appear that such variation is such as is likely to interfere with the curative value of the serums, if administered early and in large initial dose of units. There will be some uncertainty, of course, as to the exactness of the dose.

In connection with this report some facts are presented relative to causes of variations which undoubtedly occur *after* the original testing of the serum before being issued. These facts are of such material interest that an abstract is here given.

Some serums retain their potency unimpaired from three months to one year. Others deteriorate in strength as much as a third. It is stated that this is not altogether due to the presence of a preservative, since such change in strength has occurred with all the preservatives, camphor, carbolic acid and tricresol.

The value of the antitoxin unit depending upon animal experimentation must vary as the guinea-pigs vary, although they are fairly uniform in weight and condition, yet they must differ somewhat in susceptibility, all of which facts affect the standard to some extent.

Some manufacturers insert a greater number of units than is stated upon the labels, making liberal allowance for diminution in strength. As the serum is practically harmless, this is not regarded as objectionable. Some put into the bottles about as many units additional as they expect the serum to lose, while a few label the bottles as they are filled, making no allowance, and these latter samples are those which, if tested a considerable time after production, fall short of the test.

To what extent the addition of perservatives produces a fall in strength is not just clear. The moral seems to be, use antitoxin as fresh as possible, and so anticipate the loss of strength which seems unavoidable.

With reference to the nature of individual products, it is to be said, that some manufacturers issue a serum of uniform

strength; others two or more grades. We can proceed in their use understandingly so long as we can assure ourselves of the number of units to each c.cm. of any given specimen, and the date of its issue.

There are advantages in having several degrees of potency from which to choose, since we can vary the number of units desired for administration without increasing the bulk of fluid injected, and by using the stronger grades can diminish the bulk, reducing the quantity to an inconsiderable amount, a great desideratum being, as we shall see later, to use a serum which represents the greatest number of units in the smallest bulk.

The serums in use in this State are: Behring's, Aronson's (Schering's), German. Roux's, French. H. K. Mulford Company, Philadelphia; Parke, Davis and Company, Detroit; The Pasteur Institute (Gibier's), New York.

If any other of American source has been used in our State, the fact has not come within the writer's knowledge. There is no reason to believe that any of them are harmful in their composition or other than perfectly aseptic. They differ somewhat in strength and price, those of foreign importation costing the most.

These serums described somewhat in detail are:

1. Behring's. Manufactured under the supervision of Dr. Behring, by Meister Lucius and Brunning at Hoechst on Main, Germany. It is furnished in several forms, under the name of Behring's Diphtheria Remedy, classed as "Ordinary," and "Extra Potent."

The Ordinary are designated as follows:

No. 0 Phial with yellow label contains 0, 8 cc. 250-fold=200 units=Prophylactic dose.

No. I Phial with green label contains 2,4 cc. 250-fold=600 units=Single Remedial dose.

No. II Phial with white label contains 4,0 cc. 250-fold=1000 units=Double Remedial dose.

No. III Phial with red label contains 6,0 cc. 250-fold=1500 units=Triple Remedial dose.

Under the "Extra-Potent" are distinguished two strengths, D, which contains 500 units of immunity in each cubic centimetre, and E, which contains 600 units in each cubic centimetre. The following qualities are supplied:

No. 0 D	vials with	yellow	labels	= 1 cc. 500-fold	= 500 units of immunity. (Full double prophylactic dose.)	
" IID	" "	white	"	= 2 cc. 500-fold	= 1000 units of immunity.	
" IIID	" "	red	"	= 3 cc. 500-fold	= 1500 "	"
" IVD	" "	violet	"	= 4 cc. 500-fold	= 2000 "	"
" VID	" "	blue	"	= 6 cc. 500-fold	= 3000 "	"
" VIE	" "	blue	"	= 5 cc. 600-fold	= 3000 "	"

The vials containing the extra-potent serum bear the superscription "Extra-potent."

This serum is preserved from decomposition by the addition of 0.5 per cent. carbolic acid. Its manufacture and testing are under governmental control and each vial bears the official seal of inspection.

Its activity is said to be unimpaired for a year. No serum is sent out from this laboratory containing less than 250 units per c.cm.

2. Aronson's Serum. Manufactured by E. Schering, Berlin, under the supervision of Dr. Hans Aronson. It is also under governmental supervision and its potency is expressed by the Behring-Erlich standard. It is supplied in two strengths, one of 100 units to each c.cm.; the other of 200 units per c.cm. The preservative used is tricresol in a proportion of 0.4 per cent. Its activity is said to be preserved for two years.

3. Roux's (Pasteur Institute, Paris.)

This is said to possess a strength of 1 to 50,000, corresponding to 100-200 units of Behring's standard to each c.cm.

The following facts relative to these particular serums may be of interest in this connection, as showing the relative potency of equal bulks of different specimens. They have a special bearing upon the relative advantages of strong and weak serums, a point to be mentioned later.

Comparative Investigations for the Purpose of Determining the Strengths of Behring's, Roux's, and Aronson's (Schering's) Diphtheria Antitoxin.—The work was done by Dr. W. Janowski, city

bacteriologist in Professor Brodowski's Institute of Pathological Anatomy, Warsaw.

While studying the methods employed in Berlin and in Paris, Dr. Janowski observed that in Berlin the average therapeutic dose of Behring's No. 2 antitoxin was 10 c.cm., or 1,000 immunizing units. In Paris, however, he noticed that the average dose was 30 c.cm.

In severe cases in Berlin, the 10 c.cm. was administered twice, making a total quantity of 20 c.cm., and only in the severest cases was the test carried up to 30 or even 40 c.cm.

In Paris, on the other hand, severe cases required from 50 to 70 c.cm., and Janowski had repeatedly seen cases in which the patient received a total quantity of from 80 to 90 c.cm., or even a larger quantity of the antitoxic serum.

It being observed, therefore, that the quantity of antitoxin used in Paris was twice, or more than twice that used in Berlin, Dr. Janowski undertook to determine experimentally by tests upon guinea-pigs the relation which exists between the dose employed in these two cities and the actual immunizing power of each.

His results show that 10 c.cm. of Behring's No. 2 antitoxic serum contains 1,000 immunizing units, while the same quantity of Roux's preparation was equal to 500 or 600 units. The strength of Aronson's was 900 immunizing units in 10 c.cm., or practically equal to Behring's No. 2.

The strength of Roux's antitoxin is practically like that of Behring's No. 1.

Centralblatt für Bakteriologie und Parasitenkunde, Vol. XVII, 236. (1895.)

It should be said in explanation that at the time these tests were made, Behring was furnishing serums of 100 units to the c.cm., and Aronson's was of uniform strength.

4. Serum of the H. K. Mulford Company, Philadelphia and Chicago, under the name of Diphtheria Antitoxic Serum. The laboratories are in charge of Dr. Joseph McFarland.

This serum is furnished in three grades, i. e.

"Standard" (100 Immunizing units per c.c.)
No. 1 vial 500 units (5 c.c.)
No. 2 vial 1000 units (10 c.c.)
No. 3 vial 2000 units (20 c.c.)
"Potent" (250 Immunizing units per c.c.)
No. 1 vial 500 units (2 c.c.)
No. 2 vial 1000 units (4 c.c.)
No. 3 vial 2000 units (8 c.c.)
"Extra Potent" (500 Immunizing units per c.c.)
No. 1 vial 500 units (1 c.c.)
No. 2 vial 1000 units (2 c.c.)
No. 3 vial 2000 units (4 c.c.)

Tricresol is used in a proportion of 0.5 per cent. to prevent decomposition. These grades correspond closely with the form and potency of Behring's.

5. Parke, Davis & Company's Anti Diphtheritic Serum.

This is furnished in five grades, in hermetically sealed glass bulbs, and is prepared under the supervision of Dr. Chas. T. McClintock of the University of Michigan. Tricresol in strength of 0.4 per cent. is the preservative. These grades are as follows:

No. 0, 250 units for immunizing, white label.
No. 1, 500 units for mild cases, blue label.
No. 2, 1,000 units for average cases, yellow label.
No. 3, 1,500 units for severe cases, green label.
No. 4, 2,000 units for severe cases.

Note.—The containers hold the units listed, irrespective of the quantity of fluid.

Both the Mulford and Parke, Davis and Company serums are sent out with a liberal allowance in excess of the label number of units to allow for loss of strength by age.

6. New York Pasteur Institute, under the direction of Dr. Paul Gibier.

But one strength of this serum is furnished, in vials of a capacity of 25 c.cm said to contain 2,500 units or 100 units in each c.cm.,corresponding nearly to Behring's former No. 2.

Camphor is used as a preservative, in what proportion is not stated.

Methods of Administration and Dosage.—The advance in our knowledge of the best methods of applying the serum to secure certain results has been marked, due in part to continued and increasing clinical experience, aided greatly by the better plan of the unit method of expressing strength and dosage instead of adherence to the former rule of indicating the dose in cubic centimeters, minims, or drams.

The prime fact of importance to remember is that the dose is to be so many units, and we shall then use enough of the serum from any particular specimen to insure the administration of the desired number.

That this is at once the most practical and accurate method of application needs no argument and it is the plan which should be adhered to strictly.

It should, however, be understood that it is highly desirable to use a serum which contains a large number of units in a small bulk, since, by so doing, unpleasant local disturbances are avoided, the rapid absorption of the injected fluid is facilitated, and clinical experience has shown a less number of cases exhibiting joint complications and annoying skin eruptions.

A prominent dealer in this State informs the writer that many physicians insist on being supplied with the serum that is cheapest in price, assuming, no doubt, that one serum is as good as another. In this they are mistaken: The strong serums are the best and most desirable both for the reasons given above and because, in the end, they are the cheapest. Most failures with antitoxin in this State have been due, with little doubt, to insufficient dosage with comparatively weak serums.

Dosage by units should obviate this chance of failure.

It is difficult to see any large measure of economy in using two and sometimes three bottles of a serum containing a small number of units as is frequently necessary if the proper number of units is to be given, instead of securing the same total amount of dosage in a single bottle of the capacity of 4 or 6 c.cm., the difference in price per bottle being not over seventy-five cents, and in most cases, nothing.

For a case of average severity 1,000 units is not enough, and it is obviously better to buy a single quantity containing 1,500 units for $2.25 than to buy two of 1000 units for $1.75 each, or to purchase 2,000 units, in one quantity, than the same number of units in two bottles.

There is no saving of money connected with the use of weak antitoxin, and this argument is hardly worthy of consideration.

Immunity Doses.—The number of units to be administered to prevent infection in those exposed is manifestly less than that demanded in the actual presence of the disease.

The question has not infrequently been asked the writer, how a remedy which neutralizes the diphtheria poison, can have any effect in a person who has not contracted the disease.

The answer is this: Antitoxin neutralizes the poison of diphtheria not by direct chemical action upon the poisonous products which have entered the blood as the result of the growth of the diphtheria bacillus, but, as it is now believed, indirectly, by stimulating in some way certain cells of the body to either destroy the toxin directly, or to produce some substance which entering the blood there destroys it or by enabling the tissue cells to resist the influence of the poison.

Hence it is concluded that antitoxin administered prior to diphtheritic infection can stimulate the activity of these cells in advance, so that if diphtheria bacilli gain entrance, they will find the bodily condition unfavorable for their development with its consequent mischief.

For children, the immunizing dose should be from 100 to 200 units. This cannot be relied upon to protect for much more than thirty days.

It would be a wise precaution to repeat the dose, if re-exposure occurs, after the third week, or at the end of the probable period of immunity.

For an adult, the dose should be 400 to 500 units. Usually a single dose suffices, a procedure to be modified according to the danger or fact of new exposure.

Curative Doses.—This question can be stated in general terms to depend upon the time which has elapsed since the appear-

ance of symptoms, the body weight, and the gravity of the disease, and may be from 500 to 3,500 units.

For infants up to ten pounds weight, the initial dose should be 500 units, and the age need not influence in the least the use of the remedy. Injections have been made with perfect safety upon very young infants both for curative and immunizing purposes. Dr. H. M. Biggs, of the New York City Health Board, reports in the *Medical News* for December 12, 1896, the injection of 150 units into a child three weeks old, weighing but four pounds and three ounces; and 150 units injected into a premature infant, nineteen days old, born at the seventh month, and still in an incubator. This infant weighed but three pounds, eight ounces. There was no reaction and no rash.

It has been repeatedly administered to pregnant women as late as the eighth and ninth month with perfect safety. A series of cases is also reported by the same observer "in which," he says, "relatively large doses were administered to infants varying in age from *one day* up. In only seven cases was there a mild body rash; in forty-two, a local arm rash; and in no instances were there other sequelae."

Children up to 12 years of age should receive *not less* than 1,000 units at the initial dose; and adults, from 1,000 to 2,000 units selected according to the severity and duration of the disease.

Under ordinary circumstances, a second injection equal to the first should follow in from six to twelve hours, if improvement is not apparent.

If laryngeal obstruction threatens, or is present, or if pulse, temperature, and symptoms of nervous irritability indicate great severity, it will be wise to make the initial dose 1,500 to 2,000 units, or even 3,000, repeated in part or whole at the end of from twelve to eighteen hours, according to developments.

If, at the end of twenty-four hours, improvement is not indicated by abatement of pulse rate, and temperature, subsidence of nervous symptoms, and a commencing loosening of the membrane, or cessation of its extension, repeat the original dose.

If improvement be not secured after the third dose, there will be little use in its continuance.

It sometimes happens that some days after the disappearance of the membrane, more appears. In such cases repeat the initial dose.

The tendency now is decidedly in the direction of the administration of large doses, and results bear out the wisdom of this course. There is quicker convalescence, more prompt arrest of the action of the poison, and, by using concentrated serums, much less local and general disturbance than when large doses of weak serums were employed.

Time of Administration.—Whatever the dose, too much insistence cannot be laid upon the fact that the earlier its administration the better will be the result, and the more certain. Antitoxic serum must not be regarded as a last resort remedy; it is most emphatically a remedy for the first three days.

Nothing is more absolutely convincing of the power of antitoxin to arrest the results of diphtheria infection, than the results of laboratory experimentation upon animals. It is possible to fix accurately the amount of poison injected into an animal, and to determine exactly the amount of antitoxin which will neutralize its evil effect.

Careful experimentation has determined that in the case of this particular toxin, the earlier the injection of the antidote the sooner will come the cure.

The comparative results which have been observed in public and private practice, upon the death-rate which corresponds to the early or delayed administration of antitoxin are in exact accord with those derived from the laboratory experiments upon animals, and furnish additional evidence of the certainty of its power against the toxines of diphtheria.

The following figures are compiled from German Hospital reports to show approximately the influence of the lapse of time upon the action of the serum:

19 Rep'ts.	Total.	1st Day.	2d Day.	3d Day.	4th Day.	5th Day.	6th Day.	After 6th Day.	Undetermined.
Cases....	1,489	222	456	311	168	116	44	104	(68)
Deaths..	212	5	37	42	32	34	15	35	(12)
Percentages...	14.2	2.2	8.1	13.5	19	29.3	34.1	33.7	(17.6)

Adding to these reports three others, we have the following table of similar import:

22 Reports.	Total.	1st and 2d Day.	3d and 4th Day.	After 4th Day.	Undetermined.
Cases....	1,702	814	534	286	(68)
Deaths....	229	45	81	91	(12)
Percentages....	13.5	5.5	15.2	31.8	(17.6)

It will be readily noted by reference to these figures, that the mortality percentage is least among those injected the first day, and increases by considerable leaps, being three times greater in cases treated on the third or fourth day than in those on the first and second, and after the third day three and one-fourth times greater than cases treated in the first three days. (Welch. Johns Hopkins.)

Figures from the New York Health Department, from January 1, 1895, to October 1, 1896, bearing upon this same point, after excluding those moribund or dying within twenty-four hours, give mortality rates for the days of injection as follows:

First day	4.0	per cent.
Second day	5.0	" "
Third day	9.0	" "
Fourth day	13.2	" "
Fifth day	20.0	" "

(Or later.)

From April to October, 1896, 178 cases were injected within the first forty-eight hours, with eight deaths, a mortality of 4.5 per cent., deducting the moribund 1.6 per cent. Before the fifth day of disease, 317 cases were injected with twenty-two deaths; a mortality of 6.9 per cent., deducting the moribund, 3.6 per cent.

As enforcing the importance of these facts relative to early injection, the mortality rate by age is interesting and instructive:

Under 1 year	28.3	per cent.
1— 2 years	23.8	" "
2— 3 "	17.0	" "
3— 4 "	15.9	" "
4— 5 "	14.2	" "
5—10 "	10.0	" "
15—20 "	8.0	" "

Mild cases will not infrequently yield even after a delayed injection. Severe cases rarely do so. There is good reason for this failure in deferred injections. It has already been explained that antitoxin has no other effect than to stimulate certain tissue cells to greater activity, whereby their power to withstand the influence of the diphtheria poison is greatly augmented. It cannot restore these cells to life if their vitality has been destroyed. By the third or fourth day the full development of the toxin has occurred and its influence has been exerted for greater or less damage according to the resistance of the tissue cells.

Severe cases of diphtheria become complicated by the third or fourth day with septic infection from abundant growths of streptococci, and a condition of affairs exists as the result of the diphtheria infection, but which antitoxin is powerless to remove or modify.

Repeatedly will antitoxin administered by the fifth day relieve stenosis, and limit the spread of membrane, and yet the patients die, because the antitoxin cannot affect sepsis, or restore nerve function, and the impression prevails that the antitoxin is of no avail for diphtheria. Antitoxin can cure diphtheria, but it must be administered early and in adequate strength.

Dr. H. C. Wood, of the University of Pennsylvania, says: "There are few if any well observed cases of diphtheria on record in which it has been positively determined that the antitoxin administered during the first few hours after the outbreak of the

disease has failed to bring about a cure." This statement can be abundantly verified.

Laryngeal obstruction is now almost unknown in cases where diphtheria antitoxin has been administered early, and operative interference has been less and less demanded. During the past two years, the writer has seen a large number of cases of diphtheria in which he has been consulted as to the advisability of administering antitoxin. Over 60 per cent. of those seen have been sick from three to five days. Some have already received a single dose without visible result. In not one of these cases has sufficient dosage of considerable strength failed to limit the diphtheritic process: in many, it has failed to prevent death or severe sequelae in the form of paralyses, because the mischief had been already accomplished. Not a death has been observed in which the remedy has been administered in the first forty-eight hours.

The advice invariably given has been, to inject a proper dose of antitoxin; then make bacterial examinations if the case is doubtful; and talk it over afterward. If the infection be diphtheria, the antitoxin will work while the physician and bacteriologist consult.

With a considerable experience in bacterial diagnosis, the writer urges the uselessness and even the frequent fatality of delay to await the result of a culture.

If a case is doubtful enough to warrant the suspicion of diphtheria and the need of a culture, there is warrant enough for a curative dose of antitoxin. Especially since there is not the least evidence that antitoxin does any harm if diphtheria be not present.

If the use of diphtheria antitoxin has been continuously disappointing, it can be confidently asserted that the failure has been due to deferred administration and insufficient dosage. Hence again the necessity of selecting serum the potency of which is attested by authority independent of the manufacturer or his agent. This evidence can only be furnished by competent laboratory experts and not by the testimony of those who have only used it clinically.

We may, therefore, lay down as cardinal rules for guidance:

1. Use an antitoxin which contains the requisite number of units.

2. Use the form which contains this number of units in the smallest bulk of serum.

3. Inject it as early as possible, and do not hesitate to repeat in twelve, eighteen, or twenty-four hours, or sooner if circumstances demand.

4. Conduct the antiseptic and supportive treatment without reference to antitoxin. Each has its own work to do.

The power of antitoxin is limited. It cannot affect sepsis except by cutting short the course of diphtheria before septic conditions are made possible.

Antitoxin cannot cure invariably all cases of diphtheria. We cannot always determine the probable intensity of the poison, and we cannot foresee the deaths which sometimes follow from paralysis of the heart muscle, or laryngeal obstruction; nor always cure blood poisoning resulting from the growth of other micro-organisms, but we can, in a vast majority of cases, prevent these paralyses, the obstruction of the larynx, and septic poisoning, by the timely administration of an adequate dose.

Mode of Administration.—There has been no material change in technique of injection, but the various specially devised syringes have gradually shrunk in size so as to be suited to the increasing use of concentrated serums.

The two essentials of a syringe for antitoxin injection are, first, that it shall be of a construction to permit easy and efficient sterilization, and, second, that its capacity shall be sufficient to hold the entire amount to be injected, so that more than one puncture may be avoided.

The needles used should be large enough in caliber to allow ready flow of the serum, and to facilitate cleansing. Most of the needles supplied are too small, and the rubber tube connecting the syringe with the needle is not infrequently ruptured by blocking of the needle. An ordinary hypodermatic syringe and needle are not suitable, chiefly by reason of their small size.

The best method of administration calls for thorough sterilization of the skin at the selected site of injection, and the sterilization of the syringe, its tubes and needles.

The former is easily accomplished by the application of soap and water, followed by alcohol, and a 1 to 2,000 bichloride of mercury solution, or a 5 per cent. solution of carbolic acid. The latter has the advantage of exercising, in addition, a slight anasthetic effect upon the skin, and so deadening a little pain of puncture.

The quickest and most effective way of carrying out the second indication, is to place the syringe, having previously unscrewed both the front and back caps, in a clean tin pan, or other convenient receptacle, together with its needle and the connecting rubber tube, if one be used. Tepid water is to be poured in enough to cover the syringe, and the receptacle placed on the stove or over a lamp, and the temperature of the water *slowly* raised to the boiling point and maintained there for ten minutes. It is then allowed to cool. It is well, if desired, to wash out the syringe and needle previous to sterilizing by heat, with a 5 per cent. solution of carbolic acid. The needle may be left in a similar solution during the filling of the syringe.

If the physician is the owner of an Arnold Steam Sterilizer the syringe may be effectively sterilized, after thorough cleansing by exposing it to the action of the steam fifteen or twenty minutes.

The syringe should always be cleaned and sterilized at the first opportunity after its use. Do not leave it until the next time its use is desired.

If the antitoxin is in a bottle, it may be drawn up into the barrel of the syringe through the needle and connecting tube, or, a better method, after screwing up the back cap of the syringe, remove the nozzle and draw down the piston and carefully pour into the barrel of the syringe, now held upright, as much of the serum as it is intended to use, then replacing the end cap, attach the tube and needle and push up the piston slowly until all air is excluded and the needle completely filled with serum.

The serum furnished by the Parke Davis Company is contained in hermetically sealed bulbs, and directions for opening these accompany each bulb. The method is, in substance, that employed for breaking smoothly and at a selected point ordinary glass tubing; after opening, the method of filling the syringe will, of course, be drawing up the serum through the needle.

The locality selected for injection should be one where the skin can be easily raised. The areas usually chosen are the back between the shoulder blades, the thigh near the buttocks, and the sides of the abdomen. Except in young children the latter situation is preferable.

With young and nervous children it is easier to inject if an area be selected which will insure the necessary manipulations being kept out of sight.

There is seldom any soreness at the point of injection. The fluid should be injected into the loose tissue beneath the skin, *not* into the deep tissues, and the injection should proceed slowly, using one or even two minutes for the operation.

A possible precautionary measure involved in this slow injection comes from the fact that it may serve as a safeguard against the entrance into the veins of any small bubble of air which may accidentally remain in the serum, for this reason, in the experiments upon animals by the injection of carbolic acid, air and other material, Adamkiewics discovered that air can be injected into a vein and taken up by the vein, *if injected slowly*, and that it will be eliminated without harm; 10 c.cm. producing no ill effects when injected slowly; 2 c.cm., injected forcibly, proved instantly fatal. This was confirmed by repeated experiments.

If any serum remains, and it is intended to utilize it for another injection, tightly cork the bottle, and set it aside in a cool, dark place until needed. Do not use a serum which has been opened, after the lapse of twenty-four hours.

It is, perhaps, needless to say that during the necessary manipulations employed after sterilization in putting the syringe together, filling it and attaching the tube and needle, scrupulous care must be exercised to avoid any possible contamination of

the several parts which should remain in the sterilized water, or a 5 per cent. carbolic acid solution, until needed, and should then be handled with clean hands.

The therapeutic value of antitoxin, and the facts relative to its use may then be summed up as follows:

Since its use, the mortality from diphtheria has fallen from 47 per cent. to at least 10 per cent.

Administered early, it greatly diminishes the probability of subsequent toxaemia, laryngeal obstruction, and paralyses.

Injected freely, when laryngeal stenosis threatens, it will, in the great majority of cases, relieve it and render intubation or tracheotomy unnecessary.

It is practically innocuous and exerts no injurious influence upon the blood, nor interferes with the normal functional activity of the kidneys or other organs, nor induces any organic changes.

Its dosage varies; depending upon the time of injection, the body weight, the severity of the disease, and whether it be intended for protection or cure.

Dose should be calculated by units, not by bulk of serum. Immunity doses are from 100 to 500 units according to infancy or maturity. For curative purposes, mild cases may receive from 1,000 to 1,500 units, according to age, with half the quantity repeated in twenty-four hours.

Severe cases should receive initial doses of from 1,500 to 4,000 units according to age and severity repeated in full in twenty-four hours or sooner, according to the gravity of the case.

The site of injection should be an area where the skin is loose.

Both the skin and the syringe with its attachments must be sterilized. The serum is a sterile fluid and must be kept so.

Injection should proceed slowly.

The usual effect of the injection of adequate doses is an abatement of the severity of symptoms, and separation of the membrane at the edges.

Sometimes, in severe cases, the only sign of improvement is a well marked and quickly established convalescence without material change in the membrane.

Recurrence of membrane calls for renewed administration.

The injection of antitoxin, to secure the best results, must be early, within the first twenty-four hours.

Its efficiency decreases rapidly after the first forty-eight hours.

It has not the slightest effect against anything but the toxin of diphtheria.

Its use does not, therefore, indicate any abandonment of general and local treatment.

With reference to the use of antitoxin and its results in our own State, nothing authentic can be said. The dealers report a fair number of sales, but nothing like what it should be if the serum was being used as freely as in some other states. To sell more than a single bottle for a single case is rare, and this is true of the weak and strong serums alike.

The absence of large centers of population, with no public institutions of any size for children, the lack of any facilities for an accurate report of facts relative to cases, the reliance almost wholly throughout the State upon clinical features for diagnosis, and, on the whole, the comparative freedom of this community from epidemics of the disease, render any statements as to the effects of its use mere conjecture, and, at the present time, there is absolutely no way of finding out to what extent the death-rate from diphtheria in this State has been influenced by the use of antitoxin, unless one can form an opinion from the remarks of medical men in medical clubs and associations, but that there is nothing like a systematic, vigorous use of the remedy, with care in recording all facts relative to the cases is apparent to those who have closely followed the subject.

Extensive correspondence with all parts of the State justifies the statement that the use of antitoxin has been less than it should be in view of the advantages it offers, and the foregoing paper has been prepared solely with a view of affording in compact form to all who care to read without prejudice, the main facts relative to antitoxin, its use and its possibilities.

The figures and statistical tables given have been selected as examples of what the use of the serum is accomplishing; they might be duplicated, or even multiplied almost indefinitely if

it were necessary to take the time and trouble to utilize all the sources of information. Such as have been used show, it would seem conclusively, how, with the better methods of administration due to constantly increasing experience, the general results have steadily improved, and also how the accumulating evidence of the great value of antitoxic serum in the treatment of diphtheria has progressively confirmed all that has preceded it.

VENTILATION OF SCHOOL BUILDINGS.*

By S. H. Woodbridge.

It is my purpose to invite your attention to-day, with such brevity as is consistent with clearness and force, to three topics from among the many upon which it would be possible and proper to speak under the subject assigned to me.

First, the relation of air to vital energy.

Second, the cost of air supplied for the maintenance of that energy at its best.

Third, upon some simple methods, in the nature of expedients rather than elaborated systems, by which air may be given admission to school rooms and made to move through them in effective ventilating work.

First, then, as to air and its part in the production and maintenance of human vitality.

Life is a flame, not in poetry and metaphor alone, but essentially in fact. Physical energy, so far as we know anything about it, is in the last analysis the product of chemical action. With the satisfaction of chemical affinities, energy locked up in potential form in atoms and in molecules leap into active and kinetic forms, like the breaking forth of waiting strength into the song and dance and prowess of exulting activity.

Energy: Who shall completely say what or whence it is? Who shall trace its hidden path back to its source, or analyze and fathom it from its beginning down through its ever changing forms, until it thrills in our beings, or is pliant to our purposes?

Whence this strength in our human frames; this individual and this humanity's aggregate possession of energy and its capacity to direct its play? Whence also that energy not within

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us, nor a part of us, but without us, and yet so within our reach and use that through it we have come to the marvelous results which to-day fill us with wonder and thrill us with expectant awe as we wait for to-morrow's achievement?

And yet how puny is our combined strength compared with the forces that lie about us responsive to our touch. The might that propels the great steamer on the seas, or which brought you here by a power and swiftness of locomotion that dwarfs your own bodily strength to infinitesimalism, whence and what is it?

Mt. Washington, that monarch of New England's hills, rests on this huge earth of ours as a grain of sand might lie on the gilded dome of Beacon's Hill. And yet not all the physical strength of humanity combined could life a thousandth part of that mountain against the pull of gravity. But what is the pull of that mountain upon the great earth compared with the vast sum of all the mightier forces in silent work on this small earth alone? And what is earth in the great phalanx of the heavens and what its little play of energy compared with the infinite sweep of that celestial energy in the midst of which and as a part of which "we live, and move, and pliant to our purposes?"

To the understanding mind and the reverent spirit the answer to our question, Whence the energy of our life and the energy at our disposal? is ready. To such the wonder and the glory of our civilization is not in the power of steam as a thing of man's device, nor in coal as a material whose marvelous uses man's ingenuity has only in part discovered, but rather in this—that the Infinite energy, by placing itself in things material, has put itself within the reach and the use of humanity. It is the power of that Infinite energy, placed within human reach and at human disposal, which urges on the great steamer and speeds the railway train. "The strength of the hills"—in their treasures of coal and of iron—"is His also," and wherever we are borne, in our steamships or in our trains, it is by the store of His strength put within our reach, "that we move, as we also have our being."

We do not, therefore, speak irreverently when we say that physical vitality is a chemical product. We rather declare the inspiring truth that the Infinite has lodged in things material

His own might to be made ours by processes placed also at our command. We declare that vital force is imparted from the Infinite energy and through the way of His providing. We make chemistry the key which unlocks the energies stored in atoms and molecules. By such a conception we exalt our life, and we magnify the Infinite in that life.

It follows, then, because the processes of nature are exact and not loose, designed and not hap-hazard, that vitality can reach its best only by putting life into those exact relations with nature's order which have been established for it.

For the purpose of our study to-day we shall regard vital energy as a flame and the body as a furnace, with associated parts for the transformation of heat, or thermal energy, into dynamic or mechanical energy. The fire beneath the boiler imparts most of its thermal energy to the water, transforming the water by that energy into elastic steam, and that steam gives over a part, a small part, of its energy so gotten to the piston of the engine, and thence it is transmitted through crank and wheel and belt and shafting to the various and scattered points of its final application. The waste between the energy locked in the coal and that to-day made available in the product is enormous and at some future time will, perhaps, be regarded as wickedly prodigal.

In the body the burning, or energy production, is more nearly at the point of power expenditure, and the process of transformation is so highly effective that in the human or animal machine a pound of fuel in food will produce much more effective energy than a pound of coal burned under a steam boiler.

There are three requisites to the obtaining of the best results from a boiler fire, the first in the order of importance being a good draft, the second, good stoking, and the third, good coal.

The best coal will not burn without an adequate draft. The best stoking will not make a good fire with the best of coal without draft. With a strong draft coal will burn with poor stoking. Inferior coal, with a strong draft and good stoking, may make a hot fire. Of first importance, then, to *fire* is air; second, stoking; third, fuel quantity.

The same is true of the body's fires. The prerequisites to the most vigorous vitality are: First, abundance of pure air;

second, proper and sufficient exercise; third, the best of food. In this case the air is the physical furnace's draft; the exercise is the stoking; the food is the fuel. And here also we find the same order or sequence, first in importance being air in adequate quantity and purity; second, exercise; and third, food quality.

Coarse and ill-adapted food, with an abundance of pure air and exercise, produce finer specimens of physical vigor than the best of food, with impoverished air for breathing, and without exercise. Compare the robust vitality of a coarsely fed and even poorly fed out-of-door laborer with that of the most pampered in diet, breathers of the confined air of luxurious apartments, occasional dainty exercisers in softly cushioned carriages, and our point is strikingly illustrated.

Without further argument it must be conceded that that to which is generally given least importance in our thoughts, as compared with the thought given to food and recreation, is really of the greatest importance to our best vitality. We think more of our eating than of our breathing, and more of the loss of a half day's recreation than of a whole week's deprivation of pure air. Municipalities will spend money by the million for parkways for the occasional outings of their citizens, and on spread-out beauty which gratifies their pride, the meanwhile condemning as wanton waste the spending of a quarter of such sums on the sanitation of schoolhouses in which the city's educators and children are breathing for thirty hours of every school week.

We some of us need a revolutionizing of ideas as to what our physical life is; first of all a chemical product, to which air is an essential element, and for the completeness of which air *must* be had in freshness and abundance.

What relation, then, has air quality and quantity to this product? In a study of this question we shall also find that the analogy between the material and the vital flame holds good. A candle flame, a lamp flame, a gas flame is sensitive to the purity and the quality of the air in which it burns. A candle which burns in pure air with a brilliancy of 100 drops to a brilliancy of 95 when burned in air not uncommonly found in the rooms of our schoolhouses. A change of 1-500 in the

chemical make-up of the air produces a change of 1-20 in the luminosity of a candle flame; or, in other words, the change in the candle flame due to atmospheric impoverishment is 25 times as great as the change in the air's chemical makeup.

The effect of atmospheric change on a flame's vitality is still more strikingly illustrated in flames which, though apparently more robust than the candle's, are yet dependent for such robustness on an exactment of adjustment in atmospheric conditions. If through the chimney of a student lamp burning two ounces of oil an hour there passes about one cubic foot of pure air a minute, the flame burns with its normal brilliancy and power. If, however, with that cubic foot of air 1.20 of a cubic foot of expired breath be mingled, note the results: First, in the slight chemical change in the air; the second, in the vitality of the flame. The oxygen of the air by the admixture of that small quantity of exhaled breath has been reduced from 20.96 to 20.76 of the air volume. The change in oxygen proportions is about one per cent. The change with reference to the total volume of air is but 1-5 of one per cent.; that is the carbon dioxide has been increased from four parts in 10,000 to 24 parts in 10,000, a proportion sometimes though rarely found in our worst ventilated school rooms.

It is stated as a matter of record that in times of intense political excitement English audiences have remained in crowded halls until the lamp flames have died out and left them in darkness, because of the insupportable quality of the air. We may therefore be prepared for the result of the slightly changed air quality on the sensitively organized, but, under normal conditions, most robust flame of a student lamp. You know the strong, brilliant, steady flame of the perfectly burning student lamp. Breathe through this small tube as slowly as possible into the air-flow which enters the lower part of the lamp's wick tube and note the result. The steady flame wavers and flickers and drops to a diminutive, sickly, pale blue flame, strongly suggestive of physical collapse.

Something of the same sort, though in far less degree, you must have noticed at times in the fluctuation of luminosity in the table lamp flame, due to the mingling of exhaled breath as it floats in streaks, now in this way and now in that, with the air

passed through the lamp chimney. The brilliancy of the burning of illuminating gas in freely ventilated audience halls has been often noted and has been more generally ascribed to an improved quality of the *gas* than of the air in which it burns.

My point is sufficiently, though by no means exhaustively, illustrated—that point is this, that in nature's economy any change, however slight, in the conditions on which her processes are made to depend, results in changes in those processes themselves which are seemingly out of all proportion to the changes in the conditions which produced them. Nature's processes are exact; her adjustments are fine; her combinings, whether of atoms in the balance of chemical affinities, or of worlds in the balance of celestial mechanics, are exact. The slightest deviation from the established order is followed by consequences marvelously changing the nature of results. The change of an atom in the proportions making up a compound changes the entire nature of the product.

If, then, we study physical vitality as a chemical product, we are prepared to appreciate the importance of maintaining its atmospheric factor at its normal in quantity and purity. And if we bring it into analogy with that to which, in chemistry, it is most closely allied—the flame—need we be surprised, should we not rather expect that *any* change in air which would affect the luminosity of an insensitive flame would also equally, if not more seriously, affect the glow and brilliancy of sensitive human vitality?

We have not here the time to marshal the long line of corroborative evidence from the fields of analogy, experiment, and experience. The weight of testimony from every quarter is overwhelmingly in support of the correctness of our premise.

II.

We pass now to the second part of our subject, the cost of pure air. How much is it? Is it worth, in money, its cost?

This cost may and must be measured in two ways: First, in money expenditure, or that in time and labor which it represents; second, by its return either in money or in the increased power of acquiring it; for money—honest money—is in the last analysis the measure of the quality and the quantity of labor.

It is to the low, the soulless, and mercenary side of our large question that we propose to apply ourselves for the moment, and yet, in a sense to its most important side. Men are yet so generally living on the level of the purse pocket that on that plane they must be honorably met and won. There are, indeed, those of us who are more effectively moved by considerations wholly apart from and vastly above the mercantile level to whom the value of the vigor of life and the robustness of perfect health are above comparison with gold, to say nothing of silver.

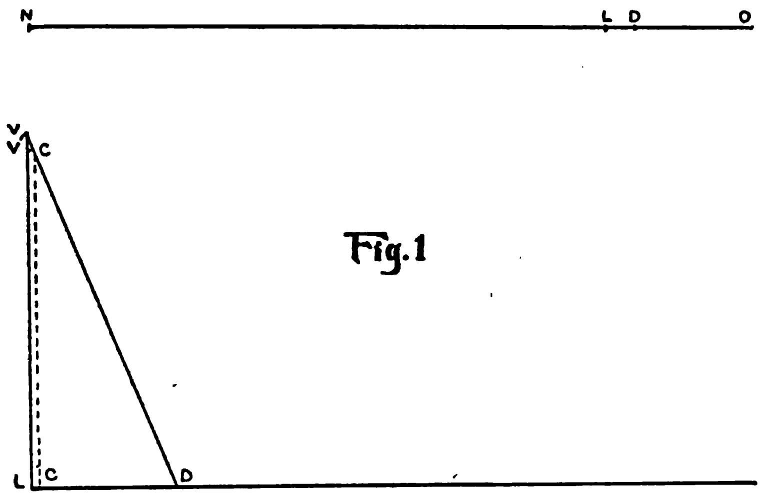


Fig. 1

Before you is a diagram (Fig. 1) which by mathematical lines represents life's and vigor's decline, due to impure air, as we have just seen it illustrated by analogy with the candle flame. The horizontal line represents the constitution of normal air, NL the nitrogen, LO the oxygen, the lengths of these lines corresponding to the normal proportions of these gases in the air. At L we find life at its best. It might not unnaturally be supposed that, as oxygen is the supporter of life, life's vigor must vary in some fixed ratio with the oxygen proportions in the air; that if life is at its best at L, it will be at its worst, that is, cease to be, when the oxygen wholly disappears from the air. But let L move only to D by the displacing of oxygen by carbon dioxide and life becomes impossible. The limits of life are therefore held not between tne points L and O, but rather within the two points L (life) and D (death).

Representing these limits on a larger scale, and graphically showing the full 100 per cent. of life's vigor at L by the line LV, and at D the absence of life, we have represented by the line VD the decline of vitality with the impoverishment of air. Let the oxygen in the air be reduced by respiration from LO to CO, as it often is in some of our school buildings, then vitality drops to V′. What is the cost of such a drop? What is the worth of VV′ preserved and not lost? It is the *crest*, the *cream* of life that is found at the *top*. That is lost, if *this* be lost. Its *keen edge* is gone.

If our estimate of the value of life is low, then the line LV is short and the gradient VD is small. If our value of life is large, then LV is high and the gradient VD is sharp, and the decline of V becomes of correspondingly large significance.

We have found that the impoverished air sometimes tolerated as tolerable in our school houses reduces the brilliancy of a candle flame five per cent. below normal. Some English students of sanitation have declared that the productive work of scholars in badly ventilated buildings falls 25 per cent. below the work of those in well ventilated school rooms. A gain of something like 20 per cent. has been unofficially reported as one of the results of greatly improved sanitation made within the last ten years in the school buildings of Chicago. A badly housed and wretchedly ventilated department of a well-known scientific school, whose location, to spare its managers public mortification, must be un-named, when moved into new, light, and airy quarters is reported to have made a gain of from 15 to 20 per cent. in yearly work accomplished. The several divisions of the Pension Bureau of the United States Government were at one time located in as many detached and scattered buildings in Washington. They are now quartered in one large, roomy, well lighted, and well aired building. Under the old conditions about 18,000 days of labor per year were lost to the government through illness in the clerical force of that one department. Under the improved conditions now existing, and notwithstanding an increased force of employes, but about 10,000 days are lost through illness—a gain of 8,000 working days, or twenty-seven years, to say nothing of the corresponding increase in the working capacity of the entire clerical force.

Such records as these, and let me say it with emphasis, are of value because of their suggestiveness rather than because of anything like their numerical exactness or arithmetical demonstration of fact. They indicate, like sign-boards, the road-ways to robust health and its full product and to debilitated powers and their costly results.

But let us for the sake of a perfectly reasonable standing ground turn once more to the story of the candle burning in vitiated air as the more reliable witness to fact and assume that its loss of five per cent. in luminosity may be safely regarded as indicative of the loss suffered by the vital flame as a result of bad air in school rooms.* What, then, is the cost of that bad air? Five per cent. of a school year lost is one and one-half weeks of school work lost. If $15 represents the annual per capita cost for educational work, the loss represented in money would be 75 cents per year per capita.

What, on the other hand, is the cost in fuel of a ventilation which would supply an abundance of pure air? One pound of coal well burned and its heat economically given to air will warm 16,000 cubic feet of air from the average winter temperature of New England up to 70 degrees F. At a supply rate of 40 cubic feet per minute for each scholar, 16,000 cubic feet would be a per capita supply for seven hours. A school room's week of 25 hours would require 60,000 cubic feet of air per capita at a cost in fuel of three and three-fourths pounds of coal. If thirty weeks represent the portion of the school year when air must be warmed for ventilating work—when closed windows and doors must shut out the waiting oceans of pure air and when fresh air must be dribbled into school rooms through contracted, crooked, dark, and sometimes dusty ways and urged through those ways under the spanking of a fan, or the torture of hot irons; and when having done its silent ministry of mercy it must be shown a way out scarcely more inviting or free than the way in—if thirty weeks represent the time when ventilation *must* be by such means, instead of by welcoming open doors and wide open windows—then 112 1-2 pounds of coal is the necessary fuel cost. The money cost of 112 1-2 pounds of coal at $5.00 per ton is twenty-eight and one-tenth cents. It therefore appears that by spending less than thirty cents per year for

fresh air seventy-five cents may be gained in school expenses and profit.

This estimated profit of 250 per cent. on the fuel investment I believe to be *lower* than experience has shown to be the money loss due to insufficient air, and that drop of five per cent. in the brilliancy of a candle flame is too short a measure for the corresponding loss of vitality in the far more sensitive vital flame.

Referring again to the official reports of the Pension Bureau, it is found that the total coal consumption for both heating and ventilation during the time when twenty-seven years were saved to the Department was 700 tons, at a probable cost of $2,800. Assuming the average pay of the Bureau's employees to be $800 per year, and also, that thirty per cent. of the coal burned represents the fuel cost for ventilation, we find the fuel cost of ventilation to be $640 against a gain of $22,400 in services rendered.

But the losses and gains are multiphazed. They are by no means represented by the single item of time or its money equivalent. Lowered vitality, increased liability to disease, its greater severity when it comes, the cost of medical attendance, the apothecary's profit, the time of others given to the sick, all these and more are among the losses legitimately chargeable to the evils of a mistaken economy, practiced on nothing so rigidly as on the freest and most needed of all things—*pure air*.

The time has come to stop the too common and ill-considered questioning about the cost of fresh air and to press home upon our public servants whom we elect to govern us and to whom we entrust our interest—it is time to urge home upon them the criminal costliness of bad air.

It is for you and for me as public educators to make this truth known and to awaken the public mind to such a knowledge of these matters that effective insistence on the human inherent right to the great universal gift—pure air—shall speedily result.

It is the engineer's part to give himself to the most conscientious, studious, and fearless effort of reducing the science of heating and ventilation to its simplest terms; aiding the architect in the arrangement and construction of his building

with reference to the simplicity, the effectiveness, and the economy of heating and ventilating work; protecting the public and the private client against the costly methods of hobbyists and the high priced blunders of rule-of-thumb contractors; and against the pit-falls of extravagance and quackery, and the knavery of professional sharks, and to train owners and users to an intelligent skill and economy in the use of apparatus. It is his function also to convict an apathetic public of criminality in robbing teachers and the taught of any fraction of their rightful vitality, and of stupid extravagance, either in denying fresh air to schoolhouse tenants, or in appointing as custodians of the public's black diamonds, men whose qualifications for such important services are often measured by irrelevant and dishonest standards.

The teacher's part in this great work of public hygiene is to insist on the obligation which compulsory attendance in public schools, or invited attendance on private schools, carries with it to surround school room occupants with the best sanitary environment; and also through the children to educate the parents to a proper sense of public duty as citizens; and to train the scholars for such good, intelligent, and broad-minded citizenship that when they shall become the city fathers, or the town's selectmen, or the school committee men, a request for fresh air will not be received as an invitation to squander public money on an aerial fad.

III.

There remains small time for the study of the third part of our subject, and I shall devote it to bringing to your notice suggestions with reference to methods of arrangement for ventilating work, which may be resorted to when expedients must be substituted for systems. It is the function of the engineer and the architect to give to you correctly and carefully wrought out systems, successfully worked into the anatomy of your buildings. It is your function to use what means you may have, or which may be available to you, whether the best or the worst, to the highest advantage.

It must be said at the outset that in this, as in everything else, good is to be gained only by sacrifice and that the pour-

ing in of pure air can be had only by the pouring out of some money. But what is money for but to be effectively poured out? The sleeping dollars of hoarded earnings are as useless as the still water of a stagnant pond. Effective energy is found only in motion, in the current of the water, in the currency of the dollar. And so, once again, I find myself reverting inevitably to this first step essential to hygienic progress and appealing to you, educators, to turn the human mind from its sordid love of money, simply a labor equivalent, to a love of that best and most permanent of things money, or its equivalent, labor, can bring—*health* of body, mind, and spirit. Life is the thing of supreme moment. Everything else is of value only as it contributes to life. Put into the highwayman's murderous threat "Your money or your life!" a message of fundamental truth and philanthropic appeal and teach it inside and outside of your school rooms.

Ventilation may be had, and generally is had, by open windows. But by resorting to such means we are likely to run headlong into one danger in the effort to avoid another. We must take our course between the two. On one side is vitiated air, which, like a slow poison, saps our vitality, and on the other side is the dagger-like draft. By the one we may die as by a slow fever; by the other as by a sword thrust.

The problem which I am going to ask you to study with me, then, is how, at small expense, to provide buildings having no adequate ventilating system with means which shall protect our vitality against both dangers and materially improve the air of school rooms.

For your encouragement let me for the first time give publicity to a bit of personal professional history. My course as a student at the Institute of Technology was chosen with reference to teaching in a favorite line of study—physics—in the hope of becoming some day a Hartwell,* not in the inspiring field of noble architecture, nor in the broad and humane fields of public hygiene, but in the fascinating walks of high school physics, and perhaps of climbing into a chair of physics

* Mr. Hartwell, of the well-known firm of Hartwell, Richardson & Driver, architects, immediately preceded Prof. Woodbridge, and Dr. Hartwell, lecturer on hygiene, Harvard Medical School, immediately followed him. Prof. Hartwell is the well-known lecturer on physics in the Fitchburg, (Mass.), High School.

in some college. That hope was blasted in the foul air of the Institute's physical lecture room, and since a certain critical day of Institute experience I have found myself swept onward by an uninvited and almost resistless current of events which has brought me up to this morning's privilege and pleasure of speaking before you.

The lecturer in that class room rarely came out of it without a sick headache and jaded strength. For ventilation purposes, large double windows were used in the best permissible manner, but the indraft was fatal when air quantity approached sufficiency. A request to be allowed to devise or to do something for the relief of the lecturer and the class was denied on the ground that thousands of dollars have been spent in vain attempts to provide proper ventilation for that building and that more could not be wasted.

For weeks I looked out of those large windows at the great floods of fresh air sweeping up to and beating against them and felt the sting of the cruelty that hindered them from fulfilling the errand of their mercy. I had something of the feeling toward that intervening and interfering glass that christendom has to-day toward the Turk, and I put myself into an active allegiance with that outside, life-giving, but excluded air.

My opportunity came, when, during a popular lecture, two of Boston's brave women, teachers I have always supposed, fell victims to that room's foul air, fainted, were carried out, and for want of any better place were laid out and restored on the marble floor of the lobby.

With that incident as a text I was given leave to intrude myself upon the authorities and to submit a plan for the room's relief, and also a reliable estimate of the cost of its execution. I was well, even heartily received; perhaps, because my plan involved the expenditure of but $15. The order to proceed was given, and within one week's time that lecture room's air became a pleasure to its occupants. The plans were adopted in other rooms of the building and are in use, with such satisfactory results to the occupants to this day that nothing better has been asked for by them.

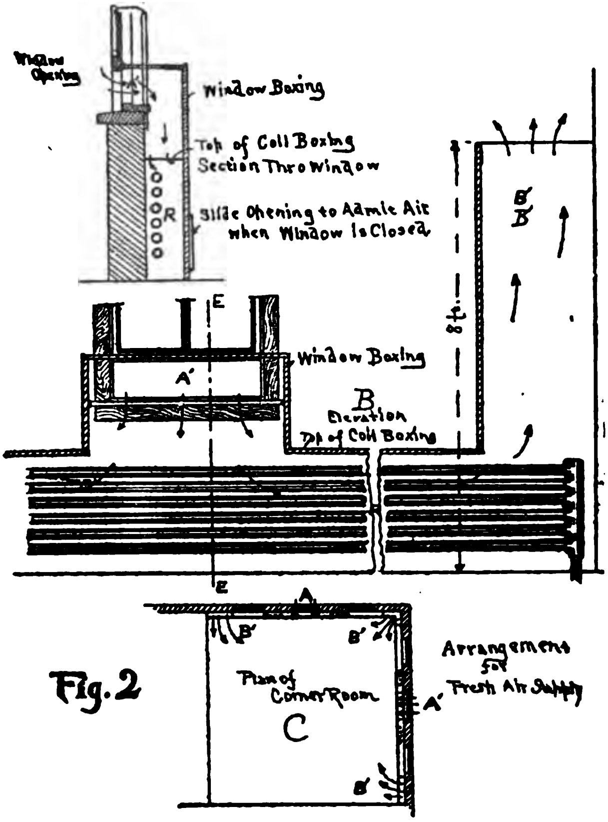
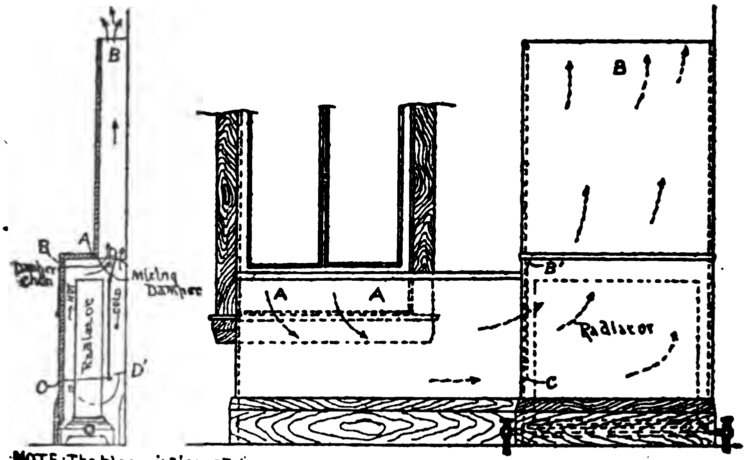


Fig. 2

The simple device used is shown in the drawing (Fig. 2) and is a method applicable to many of our buildings, old and new, which are heated by steam coils run along the outside walls of the room. Fig. 2 consists of three parts, A showing a window with lower sash raised and box connection made with the air conduit which surrounds the steam pipes. A shows a cross section of the box on line EE in part second of the figure; B shows an elevation of the same arrangement with inlet window open, the air moving both ways from the window over the steam coils to the uptakes, one of which is shown at B'; part C of the figure shows the adaptation of such an arrangement to a school room, the intake windows being shown at A'A' and the uptake flues at B'B'B'.

If school rooms are warmed by radiators instead of circula- coils, or by stoves, the air may be warmed by passage

over them before its entry into the school room by methods shown in the drawings. (Figs. 3 and 4.)



NOTE:—The plate indicated by A, B', C', D, is a stop to throw the entering cold air back of Radiator.

Arrangement for Fresh Air. Fig. 3

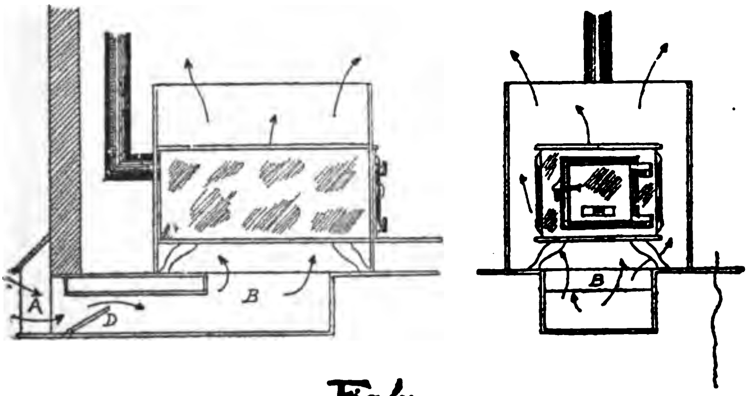


Fig. 4

Fig. 3 shows a method for passing outside air over a radiator and warming it and delivering it into a room in a manner to avoid drafts, steam being continuously upon the entire radiator, the temperature of the admitted air being controlled by a mixing damper D.

Fig. 4 shows a common type of stove for wood burning arranged for the same purpose. In this case the temperature of the inflowing air is controlled by the stove dampers.

When school rooms are furnace heated the air supply may be made much larger than is tolerable when the air passing through the registers must be first heated by contact with a furnace. The air supply moving through a furnace is reduced, first, because of the crooked and contracted course through which it must pass; and second, because that air, being made a vehicle for heat, must be controlled in the quantity of its flow by the heat quantity required in the school room. Ventilation by the furnace or allied methods of heating demands an adequate and continuous air flow and a regulation of the temperature of that flow according to requirement; or, in other words, constant air flow and variable temperature of supply. In practice we too commonly have at best an inadequate supply and one which must be varied with the temperature of the supplied air.

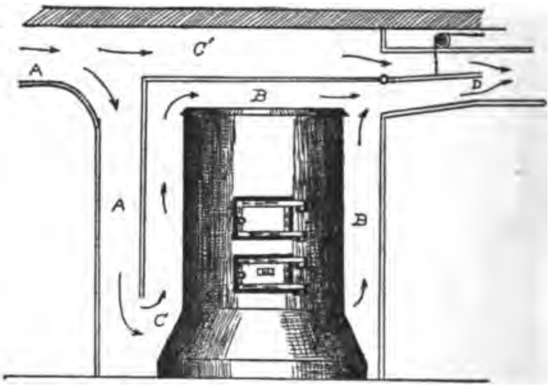


Fig. 5

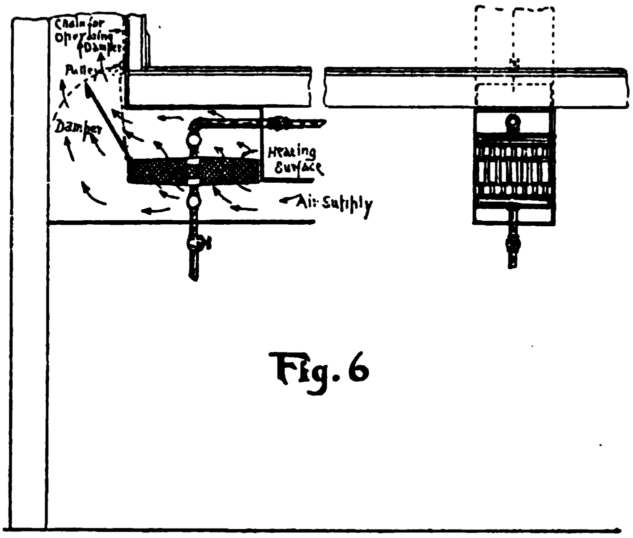


Fig. 6

The device to which your attention is now called (Fig. 5) is applicable to a furnace or any other form of indirect heater. It is an application of means for regulating the temperature of air flow without changing the quantity of that flow. For this purpose there is required a sufficient supply of cold and a like supply of warmed air and suitable means for mixing them in needed proportions for the temperature of the room.

A method of effecting this is shown in the drawing before you (Fig. 5) the cold air box A is made large, at least five square feet of cross section for one school room. It delivers air to one chamber C at the bottom of the furnace and to another C at the top. That entering the bottom chamber rises about the furnace shell and is heated; that entering the upper chamber is not warmed; each chamber has a properly proportioned connection with the supply pipes to the rooms. These pipes should have an aggregate area of not less than four square feet for the lower story. By means of valves operated by a chain and pulley connection from the school rooms the proportion of cold and hot air which shall mingle in the pipes may be controlled by the mixing damper D.

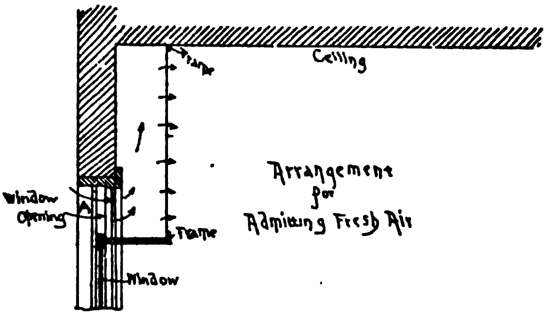
Fig. 6 shows a method of arranging an indirect steam surface for the same purpose. It illustrates a method frequently

used for by-passing air about steam or hot water indirect heaters and for controlling the temperature of air supplied through an uptake flue to rooms.

All such methods whether applied to stoves, furnaces, or steam coils are of small value unless the air-ways are made of proper size for ventilating work.

Where such means as I have described prove inapplicable, either because of their expense or because the heating apparatus cannot be adapted to such work, it is possible to resort to other still more primitive and yet serviceable methods of relief. It is by the use of open windows, the air flowing through which shall be diffused through so large a surface as to prevent drafts, and shall at the same time be warmed by mingling with the warm air of the room before it can come within reach of the occupants. This method might be applied to school rooms by inserting frames in all the windows, they carrying or being covered by some open mesh fabric, like cheese cloth or thin muslin. The linear movement of air through such an extended surface would be slow, except under action of a strong wind, but the aggregate air quantity passed would be large. The objection to thus substituting cloth for glass in school room windows is evident. The darkening effect would be a serious obstacle to the use of such means and the manipulating of the frames would be so troublesome as to result in their disuse.

Ordinary cheese cloth, when clean, offers an obstruction to air flow which reduces the rate of its movement through any given area to one-seventh of the flow through the same area when free. The large area of diffusing surfaces made necessary can be had without seriously obstructing windows by the method shown in the drawing (Fig. 7) and by the extension of that surface to two or three sides of the room, if necessary. Its position protects it from wetting and filling by rain and gives it the best opportunity for passing cold air in from the outside and for warming by mingling with the ceiling air, where the surplus of heat resides, before it can reach the floor.



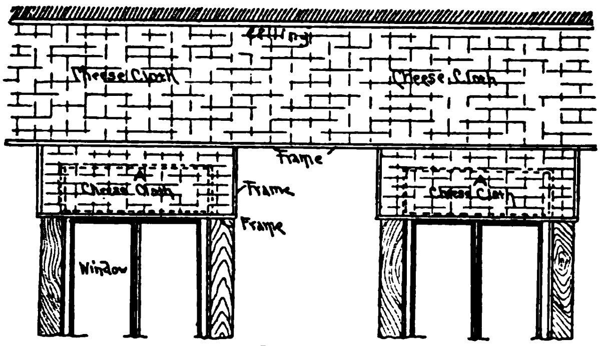


Fig. 7

For the discharge of air from rooms and buildings provision must also be made and methods must be modified to accord with circumstances. If there are and can be no exclusive and sufficient ways for the movement of air in its outward course, there may be given to it the right to share the use of hallways and stairways with those for whose service it is present and then be given final egress through a scuttle or more fitting outlet at the roof.

All this brief outlining of methods is designedly most elementary. This is neither the time nor place to enter into a discussion of the mechanics of ventilation, nor of the varied mechanisms for producing it, nor into the regions of disputation regarding results demanded and the means of effecting them. My effort in this part of my subject is to serve you by

the suggestion of means within your nearer reach for freshening your own and your scholars' lives.

In the application of any such devices as those to which your attention has been so hastily called three things should be clearly understood and continuously borne in mind.

First. The force which, without the aid of mechanical means induces fresh air to enter our buildings and to diffuse itself through them and to carry away atmospheric impurities from them is so inobtrusive and gentle that the spreading of a cobweb across its pathway through a flue may be enough to hold the air movement in complete check. Hence the necessity of providing means for ventilation in which nature's delicacy in forcing fresh air upon us shall be fittingly recognized. For, light and yielding and unstable as air is, it is steadfastly true to the law of its being and cannot be coerced. nor cajoled, nor imposed upon.

Second. The force of wind—air in its frolic or its fury—is greater than that which nature brings to us in the gentle pressure available for ventilating work. It enters as a complex and complicating factor into such work as we are considering. We cannot disregard it, much less antagonize it, for it will upset all our doing and bring our ex-parte schemes to confusion. We must rather make terms of alliance with it and shape our devices to its uses.

Third. All devices and arrangements for bettering ventilation which fall in any way short of producing results essential to good health must be regarded as expedients, to be resorted to only under the stress of necessity. There are two dangers always before us in the choice of means and of methods. One of being satisfied with mediocre results bolstered up by an active and deceptive imagination which complacently plays about the ocular evidence of good intention exhibited in ventilating systems; and second, the danger of indulged or imposed notions more costly in acquisition than valuable in possession or in use. Seek first of all efficiency, then simplicity, and with both economy.

Stand in irreverent fear of those to whom the mysteries of ventilation have been revealed and to whom alone the aerial secrets have been disclosed. Because ventilation concerns

itself with the movement of the unseen, under the action of forces which are invisible, through paths which are trackless, and with the carriage of impurities which are etherial, it will always be relegated by some to the regions of capricious art and the realm of quackery; tendencies of thinking which impose themselves to-day upon some who court recognition as authorities in the theory and as experts in the practice of ventilation and from which only the stronger and better trained minds are wholly free.

This, then, is my brief message to you. I trust that I have not misused the opportunity, nor abused the privilege you have so kindly given me. I shall go from you and from this place of refreshing and inspiration thankful if I may have spoken a word which may help any of you to make the thoughts of some men broader, or the air of some school rooms freer and fresher, or your "blow for life" stronger and surer.

At the close of the reading of Prof. Woodbridge's paper a well known educator was heard to remark that at length a mystery in his recent school experience seemed to be explained. The best teacher in his school invariably came up to the end of the year with a class of lower average grade than the classes of less able teachers were found to have. The record was one of successive years. The fine teacher habitually keeps the school room windows so closed as to make the air, by contrast with the other rooms, close. The inferior teachers are often found to have such open windows so wide open as to made cautions necessary. What brains could not do fresh air could do and for years has done.

SAND FILTRATION OF WATER, WITH SPECIAL REFERENCE TO RESULTS OBTAINED, AT LAWRENCE, MASSACHUSETTS. *

By GEORGE W. FULLER,

Biologist in Charge of the Lawrence Experiment Station, State Board of Health of Massachusetts.

With the increase in our knowledge of epidemiology, and the causation of certain diseases, it has become clearer than ever before that more careful attention must be given to the quality of water supplies. It is true that drinking-water is not the source of all deaths from diseases, the germs of which are known at times to be water-borne. Certain weight must be given to infected milk and other foods, to deficient drainage and sewerage, to neglect of laws of personal hygiene, and to other sources. Owing to the general absence of the results of sanitary analyses and of sanitary inspection, it is impossible to state at present how important is the part played in the transmission of diseases by each of these sources. In the case of water, however, it is positively known that its part in the causation of certain diseases is a prominent one; authorities differ only as to the degree of its prominence.

Sanitarians clearly realize that opportunities for supplying large communities with pure drinking-water from ground water sources, or from surface waters taken from uninhabited watersheds, are becoming fewer and fewer. They recognize, further-

*Read at the Montreal meeting of the American Public Health Association.

more, that the time has fully arrived when strenuous efforts must be made, in the interests of the public health, to afford practicable and reliable means for freeing infected water supplies from disease-producing germs.

Bacteriology teaches us that water may be sterilized in three ways, by means of chemicals, by means of heat, and by means of filtration. While chemicals have been of much aid in surgery by bringing about antisepsis and asepsis, it is very improbable that people would allow their drinking-water to be drugged with chemicals, even with the view of removing dangerous bacteria—indeed, such a method might prove very dangerous in many cases. Heat is a much safer means of sterilization, and its application in the household has doubtless done much good. But on the ground of practicability and economy, as well as of reliability, in the light of our present knowledge, each of these methods of sterilization for the removal of disease-producing germs from water-supplies drops into relative insignificance when compared with filtration.

At the annual meeting of this Association at Chicago last year, I had the honor of presenting to you some of the results of the investigation upon water-purification made by the State Board of Health of Massachusetts. It was then shown that all disease-producing bacteria in the Merrimack river at Lawrence may be removed by slow intermittent filtration through fine sand and loam. But this is not all that the filter accomplished in the removal of bacteria. Out of 102 analyses, 58 indicated that the filtered water was absolutely sterile. Furthermore, the few bacteria which were found in the effluent from time to time belonged to the most hardy species of water bacteria, many of which existed in the form of spores and which, let it be understood, are not killed by the ordinary application of heat or of chemicals.

Spring water obtained from favorable sources has repeatedly been found to be absolutely sterile. This is the result of natural filtration. This is Nature's method of purifying water, and the efficiency of natural filtration may be attributed to the retention of the bacteria within the filter under an unfavorable environ-

ment. The natural consequence of these unfavorable conditions is the survival of the fittest bacteria. Now the evidence at hand shows that the disease-producing bacteria are among the first to succumb, because farthest removed from their natural habitat. The non-pathogenic bacteria eventually perish, also, but unlike the case with the dangerous species, this does not happen until they have established a home and breeding place within the filter. Under the most favorable conditions, filtration may be conducted so that no bacteria pass through with the filtered water. This can only be done under circumstances where the discharge from the filter is sufficiently removed, by time and distance, from the main seat of bacteria activity.

We know that there are a score or more of germs which may produce specific diseases in mankind. There are many more species which are of the utmost benefit to the human race. They accomplish their work by decomposing and nitrifying processes, and convert objectionable organic matter and disease germs to harmless mineral matter. The benefit to mankind of the saprophitic bacteria, cannot be overestimated. In this connection it is instructive to quote the conclusion from Pasteur's admirable investigations: "Whenever and wherever there is decomposition of organic matter, whether it be the case of an herb or an oak, of a worm or a whale, the work is exclusively done by infinitely small organisms. They are the important, almost the only, agents of universal hygiene; they clear away more quickly than the dogs of Constantinople or the wild beasts of the desert the remains of all that has had life; they protect the living from the dead; they do more, if there are still living beings, if, since the hundreds of centuries the world has been inhabited, life continues, it is to them we owe it."

In no place in Nature are the opportunities for this bacterial activity more favorable than in filters. We find that the purification of water, with the removal of disease-producing germs by filtration, is Nature's method. We may go a step farther and state that in the purification of water that method is safest which follows most closely Nature's method, and which is least dependent on human agencies.

Nature's method of filtration means the intermittent application of water to sand or soil in rates equal to the rainfall. The economic adoption of sand filtration, particularly as it has been practised successfully for many decades in Europe, differs from Nature's method, strictly speaking, in that the rate of filtration is much higher and the surface of the sand or soil is covered with water for long periods of time. The essential, underlying principles, however, are the same, because the results are produced by bacterial activity which permanently exists in all filtering materials.

While the removal of pathogenic bacteria by chemicals, including coagulents, and by heat, will forever be directly dependent on human attention and judgment, I venture to predict that the day will come when the knowledge of filtration among sanitary scientists will be such that filters may be constructed and operated by which water, free from objectionable bacteria, will be supplied to hundreds of thousands of citizens and require the attention of a mere handful of men.

Even under these circumstances the opportunity for exercising personal attention and judgment can be reduced to very narrow limits. In order to obtain this desirable end it is necessary to study thoroughly the laws of filtration from engineering, bacteriological, chemical, and hygienic points of view.

For the past seven years the State Board of Health of Massachusetts has been studying the laws of filtration at the Lawrence Experiment Station. In a certain sense, the Lawrence work may be regarded as investigations upon Nature's ways of working, with a view to their more economical and advantageous application to the problems in actual practice. The results of these investigations have been published from time to time in the annual reports of the Board. It is fitting on this occasion that I review some of the more important points upon the filtration of water in the annual report of the Board for the year 1893, which is just issuing from the press.

In the operation of a filter, one of the important points is the rate at which water passes through the filtering material. As a result of European experience, the conventional limit has

been set at from 2,000,000 to 3,000,000 gallons per acre daily. Recent results obtained at Lawrence show that the Merrimack river water may be filtered through proper materials at the rate of 4,000,000, 6,000,000, and even 8,000,000 gallons per acre daily, with practically no diminution in the bacterial efficiency. Farther investigations are necessary to show whether filters may work at this rate for an indefinite time without a period of absolute rest. The maximum rate of filtration allowable depends upon the quality of the water and the quality and quantity of the sand. The advantage of higher rates of filtration with undiminished hygienic efficiency is apparent because it means reduced size and cost of the filtering plant.

It is well worth noting that in the operation of water-filters a greater hygienic efficiency is obtained from uniform than from fluctuating rates of filtration. The disadvantage of fluctuating rates has been demonstrated in the case of some of the older water-filters in Europe. From the Lawrence work it appears that with filtering materials of increasing degrees of coarseness and with higher rates of filtration the advantage of uniform rates becomes more marked.

Concerning the depth of material it has been found that while very satisfactory results may be obtained, under favorable conditions, from filters one to two feet deep the deeper five foot filters are safer.

The investigations indicate that, within the limits in sizes of sand grains which would be usually employed in filtration, the finer sands are ordinarily slightly more efficient in removing bacteria than the coarser ones.

It has been stated that an objection to sand filtration of water is that the hygienic efficiency is materially reduced during the period which immediately follows the scraping of the surface to relieve clogging. In the light of recent Lawrence results, this period of somewhat diminished efficiency appears to be largely due to mechanical disturbance of the main body of the filtering material during the process of refilling the filter with water after draining and scraping it. The effect of this mechanical disturbance, caused largely by escaping air, is to create places of

lessened resistance to the passage of water through the filter, thereby allowing the water to pass through certain limited areas of the material at very high rates and under abnormal conditions of filtration.

It has been found that there are reliable and practicable means of overcoming this difficulty;—one method, for instance, is by slowly filling the filter from below after draining.

In regard to the application of water to filters, there are two methods: first, the continuous method by which the filters are continuously operated with the surface of the sand constantly covered with water—and second, the intermittent method by which, from time to time, the water is shut off from the surface for a certain period and the water allowed to drain out of the sand, the pores of which fill with air. The advantage of intermittency is that it provides, within the filtering material, an additional amount of oxygen, with which the bacteria may perform their functions.

So far as the experimental filtration of the Merrimack river water at Lawrence is concerned, there is no marked difference in the average results which may be obtained by the two methods of application of water. The reason of this is that a practically sufficient quantity of free oxygen is held in the water as it flows on to the filters. In 1880 it was shown that a small amount of oxygen (one to three per cent.) in the air of a sewage filter was effective, provided that the air was changed so often that some oxygen was always present at every point. That continuous filters at Lawrence are supplied, under ordinary circumstances, with sufficient oxygen is shown by the fact that it has never been found absent in the effluents as they flow from the filters through trapped outlets. This is confirmed by the results of long series of analyses of the effluents from both continuous and intermittent filters.

Moreover, the analyses of the filtering materials themselves showed that the sand from intermittent filters contained substantially the same amount of organic matter as that from corresponding continuous filters.

To make clearer the interpretation of the investigations upon this point, let me state that the quantity of free dissolved oxygen

in a water depends chiefly upon temperature and pressure. As there is practically no increased pressure upon water as it flows on to filters, the amount of free oxygen held in the water varies with the temperature and generally speaking, cannot exceed the point of saturation for the given temperature even after aeration. The maximum quantity of free oxygen held in water varies from 1.47 parts at 32° Fahr. to 0.81 part at 80° Fahr., expressed by weight in parts per 100,000. Now it will be seen that the quantity of free oxygen, which is absolutely essential to chemical and bacterial purification of water by sand filtration, cannot exceed a fixed quantity in different waters, under parallel conditions of pressure and temperature—while the amount of organic matter in waters under the same conditions may increase within wide limits. The quantity of free oxygen within the filter, which will suffice for the complete purification of the water, must be in proportions corresponding to the organic matter. For this reason it is clear that spring waters and other waters which contain relatively small proportions of organic matter can be filtered by the ordinary continuous method with complete success, while the filtration by this method of sewage, which contains a comparatively large quantity of organic matter, is an absolute failure. Intermediate between the two in point of organic matter, a line must be drawn, below which either the continuous or intermittent method of application of water to filters is allowable, but above which the intermittent method may alone be used with safety. Not only the quantity, but also the quality of the organic matter, must be taken into consideration, for it is well known that animal matter is more easily decomposed and mineralized than organic matter of vegtable origin.

With regard to the experience at Lawrence, it may be stated that during mid-summer, the period of greatest bacterial activity within the filters, and also the time when the amount of free oxygen in the Merrimack river water is least, intermittent filters give somewhat better results. On the other hand, during midwinter, when the Merrimack river water is saturated with oxygen, the advantage appears to lie somewhat in favor of the

continuous filters because they are more protected from the effects of freezing weather.

In order to obtain the required amount of free oxygen, it is necessary in the case of some waters, and absolutely essential in the case of sewage, to charge the pores of the filter with oxygen from time to time, because the quantity which can be applied in the water is limited by the point of saturation. Therefore, the arbitrary adoption of the continuous or intermittent method of application in the filtration of a certain water is not advisable. It becomes a matter of adjustment of the necessary quantity of free oxygen within the filter to the amount and quality of organic matter in the water under consideration.

We have now considered the way in which sand filtration does its work, and referred to some of the controlling factors in its operation. Let us next turn to the hygienic results obtained by filtration and to their interpretations.

At the Lawrence Experiment Station, during the year 1893, there were made more than 12,000 bacteriological analyses in repeatedly testing the efficiency of twenty individual filters of different construction and operation. The average results of these analyses indicated that 98.54 per cent. of the number of bacteria in the Merrimack river water were removed by filtration. This average includes all normal results, many of which were obtained from filters and under conditions which would not be recommended for adoption in that capacity. Under reasonably favorable conditions, the removal was from 99 to 99.5 per cent. of the number in the applied water. Of the average percentage (1.54) of bacteria which remained in the filtered water, in actual numbers 140 as compared with 9,100 in the river water, a majority appear to belong to the most hardy forms of water bacteria. Furthermore, it has been learned that 15 to 25 per cent. of these bacteria are present in the form of spores, which, as has been stated above, are not killed by the ordinary application of heat and of chemicals.

In studying the hygienic efficiency, we are not dependent alone on the results from these water species of bacteria. Billions of typhoid fever germs, B. coli communis and B. prodig-

iosus, a species which is similar in its mode of life in Merrimack river water to B. typhi abdominalis, have been cultivated and applied to the filter. When these germs were put on to the filters, in numbers corresponding to the water bacteria, under high rates of filtration, they passed through the filter into the effluent in very limited numbers. They were present in the filtered water, however, in relatively much smaller numbers than the common water bacteria. Under parallel conditions, the ratio of B. prodigiosus to common water bacteria in the effluents, appears to range between 1 to 10 and 1 to 5. The average number of these germs, applied in pure culture to the filters, was 6,000 per cubic centimeter, of which 99.81 per cent. were removed by the filters.

The reason why such large numbers of these specific bacteria were applied to the filters was to test the efficiency of filtration under different conditions, and to obtain numbers sufficiently great to show clearly the laws of filtration. It will be admitted by every one, that the tests upon the efficiency of the filters in removing these bacteria were far more severe than would ever occur in practice. Looking at the experiments more carefully, it is seen that these germs were applied to the filters for weeks, in numbers equal to those of the ordinary bacteria in the Merrimack river at Lawrence. At times, in fact, the numbers were a hundred fold greater. In order to appreciate more fully these experimental conditions, let me state that in order to obtain in actual practice, corresponding numbers of typhoid fever germs, it would be necessary to add to the drainage of the Merrimack river, above Lawrence, a population sick with typhoid fever and equal in number to the present inhabitants. This statement assumes, of course, that there would be conditions corresponding to the present with regard to sedimentation, the effect of light, temperature, osmosis, etc. It may be safely stated that the experimental conditions at Lawrence are a hundred fold more severe than would ever occur in the filtration of an ordinary water supply. This shows what a large factor of safety lies behind the bacteriological investigations at the Lawrence Experiment Station, and furthermore may serve to explain

the confidence with which those who are familiar with these investigations believe in hygienic efficiency of the sand filtration of water supplies.

The results from the filtration of water at Lawrence are no longer confined to the experimental stage. A filter to purify the water supply of the city of Lawrence has been for the past year in successful operation. From an engineering point of view, this filter contains many important features which are described in the forthcoming report by its designer, Mr. Hiram F. Mills, chairman of the committee of the State Board of Health, upon water supply and sewerage.

Briefly, it is 2.5 acres in area and contains sand of an average depth of about 4.5 feet. The depth of sand varies from 3 to 5 feet, but owing to the arrangement of the under-drains, all water passes through at least 5 feet of filtering material. The filter is situated by the side of the Merrimack river and separated from it by an embankment. Its surface is 2 feet below low water in the river. The water is allowed to flow on to the filter about 16 hours a day on an average, and during the remainder of the time the sand is drained and the pores filled with air. The filtered water is conducted by under-drains to a collecting conduit and thence to the pump-well. The pumps determine the rate of filtration and are speeded so that the water shall pass through the filter at the rate of 2,000,000 gallons per acre in 24 hours. From the pumps the water passes to the open distributing reservoir which is 25 feet deep at high water and contains 40,000,000 gallons. The water then flows by gravity from the reservoir to the consumers.

From the time when the filter was put in operation, September 20, 1893, until May 1, 1894, daily bacteriological analyses, in addition to numerous chemical analyses, were made of the water before and after its passage through the filter, as it leaves the reservoir and from taps at the city hall Experiment Station, which are distant 1.5 and 2.5 miles respectively from the reservoir, the results were as follows:

	Average number of bacteria per cubic centimeter.	Average per centage removed of number applied.
River	19,900	.....
Effluent at filter	264	97.58
Water from reservoir outlet	139	98.73
Water from tap at city hall	90	99.17
Water from tap at Experiment Station	82	99.25

The above averages include all results. Excluding those results obtained under conditions which were abnormal and not likely to occur again, we find that this filter normally reduced the bacteria from 9,000 to 150 per cubic centimeter—a removal of 98.3 per cent. of the number applied. Owing to the fact that some ground-water of some what unsatisfactory quality with regard to numbers of bacteria, was at times mixed with the effluent, it is very improbable that all the bacteria in the water pumped to the reservoir passed through the filter.

During the five years preceding the use of the filter, the average annual death rate from typhoid fever in Lawrence was 1.27 per thousand inhabitants. The population of Lawrence is 50,000, and this average rate is equivalent to 63 actual deaths per year. During the past year there have been 26 deaths from typhoid fever, a reduction of 60 per cent. Furthermore it has been learned that of the 26 who died, 12 were operatives in the mills, each of whom was known to have drunk unfiltered and polluted canal water, which is used in the factories at the sinks for washing. Among the operatives of one of the largest corporations, where canal water is not used, there has not been a single case of typhoid fever during the past year.

The test of the efficiency of the filter during the past year has been a fair one, because at Lowell, the sewage of which enters the Merrimack river, nine miles above the intake of the Lawrence filter, there was during the past winter a severe epidemic of typhoid fever.

In conclusion, we may state, that it has been found practicable to protect the consumers of infected water supply by means of sand filtration.

THE APPLICATION OF INTERMITTENT FILTRATION TO DOMESTIC FILTERS. *

By George W. Rafter, Rochester, N. Y.

If one were to propose to an association of practical water works managers as a question for discussion, which is more important—whether to secure for large cities an abundant supply of water of medium quality, that is, a supply which may at times be bad, or a restricted supply of absolutely unexceptionable quality, that is, a supply which will always be good—we would find, I think, the consensus of opinion decidedly in favor of the abundant supply of medium quality.

If, however, we propose the same question to an association of hygienists, we will probably be told that as regards standards of purity of public water supplies nothing is admissible which can by any possibility contain the germs of infectious disease; and while we may tacitly accept this latter as the final conclusion of recent scientific endeavor, we, nevertheless, find ourselves, when we attempt to obtain a public supply for a large city which answers to this requirement, confronted with the stern fact that, aside from small quantities of sparingly distributed spring water, practically no such supplies exist.

We learn, then, at the very outset, that in the selection of the great majority of public water supplies there must be a compromise as regards quality, and it is largely due, without doubt, to this nearly universal rule the idea has become so generally prevalent that the first consideration should be abundance,

* Read at the annual meeting of the Buffalo Academy of Medicine, June 26, 1894.

quality only entering into the account when the equation of quantity is fully satisfied. Further, if we examine the matter in detail we shall find that in selecting the water supplies of most of our American cities and towns, quantity has thus far been the sole consideration governing; and that, other than remotely, quality has not been considered at all.

Moreover, even when we throw quality largely out of the account, the choice is not always easy because of great expense, and when we assume, as the teachings of hygiene show that we should, certainly medium quality, the choice even then frequently becomes a matter of extreme difficulty.

A number of years ago the present speaker had occasion as a part of his ordinary duties to examine somewhat in detail every possible source from which either a temporary or permanent supply of potable water could be drawn for the city of Rochester. In the course of the study something like eighteen distinct sources were examined, with the result of showing that taking into account everything, the choice was really narrowed to Hemlock lake, the source formerly selected, which, while admittedly a source of inexceptionable quality, was still, in the opinion of many citizens of Rochester, hardly available as an additional supply by reason of the great distance (thirty miles) which the water must be transported.

The result of a fairly exhaustive examination was to show, however, that taking into account quality as well as cost of obtaining a given quantity, it followed that Hemlock lake, even though thirty miles distant, was by far the preferable source of supply for the city of Rochester.

Western New York, looked at casually, would be considered a well-watered region, and since making the examination in question it has always seemed to me an exceedingly interesting fact that the repeated selection of Hemlock lake as the natural source of the potable water supply of the city of Rochester, by all the engineers who have examined the matter in detail since about 1860, when it was first proposed, down to the present, should show clearly that potable water of high quality and in large quantity is in reality rather a scarce commodity in

Western New York. At any rate, we may draw the conclusion that the theoretical hygienic standard is in many localities practically impossible of attainment.

The foregoing may be taken, then, as indicating—albeit rather rapidly—that there are as yet but few public supplies, the water of which can be safely used for drinking without preliminary purification of some sort.

The art of filtration has now so far developed that the indispensable preliminary purification can be certainly obtained in every case where municipalities are willing to meet the additional expense, but it must be understood that thus far only a few American towns have shown themselves willing to provide this remedy for the entire supply. The reasons for this apathy may be found mostly in (1) a lack of appreciation of the importance of furnishing drinking water of the hygienist's standard; and (2) the considerable expense of filtering the whole supply for the purpose of furnishing drinking water, which naturally is only a very small proportion of the whole. Hence it results that practically the only way safe drinking water can be obtained from the average American public supply is by the use of domestic filters, wherein the drinking water of each family may be purified as used from day to day.

That there is a real demand for an efficient domestic filter, one that can be relied upon to furnish absolutely pure water at all times, to sterilize it in short, may be sufficiently illustrated by considering that since 1880 about 1,000 patents have been issued from the United States Patent Office for domestic filters alone. Nearly all of these are not filters in any proper sense of the word, but are merely strainers, and possess the defect of either clogging or else failing to purify at all.

In view of the demand for a good filter, the fact that only one or two of these have come into even moderate use is very satisfactory proof of lack of the essential qualities of a good filter in nearly the whole series.

Broadly, we may classify filters as either continuous or intermittent.

In continuous filters, water is passed through the filter in a continuous stream, the rate of flow depending, in many cases,

upon the personal whim of the designer, and in others upon natural limitations imposed by the filtering material. With sand filters operated continuously, experience has indicated a certain rate beyond which it is impossible to operate and secure any special improvement of the effluent.

In intermittent filters the water is passed through the filtering material intermittently—that is, with intervals between each application of water. In such filters the material is preferably coarse, clean mortar sand, and the intervals of application are made long enough to insure the sinking of each dose of water below the surface of the sand before another application is made. In continuous filters, on the other hand, nearly every possible variety of material has been used, as, for instance, sand, gravel, charcoal, felt, porous stone, porous porcelain and many others; but at present sand, charcoal, porous porcelain and porous natural stone are the ones in more general use.

In order to understand the conditions essential for a perfect filter we need to consider briefly (1) the nature of the impurities to be got rid of by filtration; and (2) the rationale of the filtering operation itself.

Throwing out of account mineral impurities which are not, so far as effect on health is concerned, generally speaking, serious in any water likely to be selected as the source of a public supply, we may classify the ordinary impurities as: (1) Suspended impurities, which may be taken to include all miscellaneous particles of matter, either vegetable, animal or mineral, which have gained access to the water together with the minute forms of microscopical life, such as the algae, infusoria, rotifera, entomostraca, etc.; and (2) the dissolved impurities, including the nitrogenous products of decomposition; (3) disease germs —as for instance the germs of cholera, typhoid fever, and the like.

In a general way we may say that a water is satisfactory from the points of health, taste and comfort: (1) When it is free from suspended matter, both animal and vegetable; (2) when it is either colorless or nearly colorless; (3) when it contains enough dissolved oxygen to render it bright and refreshing;

(4) when it contains not only no disease germs but also nothing which can by any possibility serve as a nourishment for such germs should any by chance gain access.

The perfect filter must be so arranged, then, as:

(1) To remove all suspended matter.

(2) To render a brown-colored water either colorless or nearly colorless.

(3) To furnish an effluent containing, at any rate, nearly the normal amount of dissolved oxygen.

(4) To furnish an effluent containing neither disease germs nor the nutrient food of such germs.

As a final condition of a perfect domestic filter, we may lay down the proposition that it must be so designed as to do its work efficiently for a long time without any attention. In the great majority of private houses there is no one sufficiently skilled in the theory and practice of filtration to give a filter such daily attention as most of those now in common use demand. The perfect filter must, therefore, be self-cleansing and automatic. Anything short of this is not in line with the best recent thought on domestic filtration.

We may now examine the theory of filtration a little in detail.

In the first place, it has been known for a long time that when impure water is poured upon porous ground at intervals, and in not too great quantities at any one point, it is not only quickly absorbed, but is found when flowing out, as from springs at lower levels, to be more or less completely freed from the organic impurities originally contained. This is Nature's process of purification, and in those localities where the proper materials exist naturally, as for instance in extensive sand areas, the water of the region, howsoever impure it may have been naturally, is rendered absolutely pure after filtering for a short distance through the ground. So marked is this action, that ordinary city sewage when intermittently applied, may be so far purified by filtration through only five feet of clean sand, as to be indistinguishable by either chemical or bacteriological tests, from what are in most places considered to be unexcep-

tionable sources of water supply. The present speaker has on several occasions drunk of the effluent from such sewage filters, so far as he knows, absolutely without ill effect.

The old idea of a filter was that of a strainer purely, but as the result of recent advances we now know that the purifying action of the soil in the case just considered is due to several distinct processes, as for instance:

(1) Simple filtration (i. e., straining) or the separation and retention of the suspended matter.

(2) The precipitation and retention of the various organic substances in solution.

(3) The oxidation of the organic matter so arrested and retained, by the action of living organisms.

This latter step involves what is known as the process of nitrification, wherein two living organisms, which are specially designated as the nitrous and nitric organisms, absolutely resolve, when the proper conditions obtain, the objectionable organic matter of water into innocuous forms. Moreover, the nitrifying organisms are inimical to disease germs and other forms of bacterial life. It, therefore, follows that any water which has been thoroughly exposed to the nitrifying action is not only freed of bacteria—sterilized—but has also been freed, by the same operation, of bacterial food. If, then, such water should, after filtering, become accidentally contaminated we may expect—what has indeed been found by experiment to be the case—that the new growth thus introduced will be relatively less luxurious than it would be in the effluent of any mere straining filter where dissolved organic matters are presumably mostly not removed.

As another attribute of the perfect filter we may say, then, that it must be so arranged as to permit the nitrifying organisms to do their work of reducing the organic matter of the treated water. By way of showing how this may be brought about, let us consider the present state of information in regard to nitrification.

As long ago as 1862, Pasteur, having in mind that fermentation was due to the action of living agents, advanced the idea

that possibly the production of nitric acid in soils might also be due to a similar agency. Again, in 1873, A. Müller remarked that while the ammonia of sewage often changed rapidly into nitric acid, nevertheless solutions of ammonia and urea prepared in the laboratory remained unaltered. Müller suggested a ferment which was absent from the pure solutions prepared in the laboratory, but made no attempt to verify this by any experimental determination; and it was not until 1877 that Schlössing and Müntz established the true nature of nitrification. In their paper published in that year they demonstrated by a series of brilliant experiments that nitrification must be the work of a living organism.

The next step was to discover and isolate the nitrifying organisms, and although Schlössing and Müntz fully recognized the importance of accomplishing this and materially advanced our knowledge of nitrification, still it is doubtful if they ever worked with really pure cultures. Certain difficulties of technique came in, which it is not necessary to refer to here, but which still delayed the final demonstration until 1890, in which year Dr. P. F. Frankland, in England, and Winnogradsky, in Switzerland, both announced the discovery of and described organisms capable of oxidizing ammonia to nitrates. At about the same time Warington, in England, and the biologists of the Massachusetts State Board of Health at Boston also succeeded in obtaining pure cultures of these organisms.

Without pursuing these interesting experimental researches at greater length, we may now state that the ascertained facts indicate that nitrification takes place in two stages, each characterized by a distinct organism. The office of one of these is to convert ammonia into nitrite; while the other converts nitrite into nitrate. Hence we have the nitrous and nitric organisms or ferments. Both are present in ordinary soils in enormous numbers; they are also present in natural waters and in sewage, where they quickly develop under certain conditions in quantity.

The conditions of success in nitrification, so far as ascertained, are:

(1) The presence of the natural food of the organisms.

(2) The presence of a sufficient supply of oxygen. The vast importance of this condition upon filtration will appear as we proceed.

(3) The presence of a salifiable base with which the nitric acid when formed may combine.

(4) A favorable temperature of the materials to be nitrified. Experiments show that nitrification is most active between the temperatures of 55° F. to 95°. Above 95° it diminishes rapidly until at about 130° F. it ceases entirely. Below 55° it diminishes, but does not entirely cease until about 32° is reached. As regards domestic filtration, the usual temperature of about 70° at which houses are kept may be considered, then, a very favorable one, as insuring the activity of the nitrifying organisms at all seasons of the year.

(5) Nitrification takes place best in the dark.

With the necessary conditions of nitrification before us we see at once why all sand filters worked continuously are of necessity foredoomed to failure. At the best such filters can only act as strainers with the result of either soon clogging up and entirely ceasing to work until cleaned, or else the interspaces become so filled with the organic matter strained out as to furnish breeding places for any bacteria present in the water, until, as has actually been found to happen, such filters often send out an effluent containing more bacteria than in the original water. The reason for this is that continuous filtration violates that fundamental principle of nitrification which affirms the presence of a considerable quantity of oxygen as an indispensable condition; hence, the working of any filter continuously is likely to lead, by an accumulation of organic matter in the interstices of the filter, to an aggravation of the evil which filtration is intended to correct.

It is, of course, true that all natural waters contain a certain quantity of dissolved oxygen, and to the extent of the influence of this there may be some slight nitrification in continuous filtration. Experience, however, has shown that the dissolved oxygen alone is insufficient to produce anything like an efficient resolution of the contained organic matter. And we may,

therefore, take it as settled that intermittency of application is one of the indispensable conditions for complete nitrification.

The theoretically perfect filter will, therefore, be one embodying arrangements for supplying water in the proper quantity intermittently and at the same time insuring a sufficient supply of oxygen. The nitrifying temperature and absence of light are matters of detail easily attained and which need not be specially described here.

The filtering material will be clean, sharp sand resting upon gravel supported at the bottom of a filter barrel. The sand should be arranged in graduated layers progressively finer from above downwards. A layer of loam may be introduced a few inches from the top, although such a layer is not necessary for the success of such a filter. The chief office of the loam would be to introduce the nitrifying organisms, although now that we are able to cultivate them artificially they may be introduced at will to all parts of the filter and consequently the layer of loam becomes less necessary than before the methods of artificial propagation of the nitrifying organism were worked out.

Such a filter operated intermittently will perpetually resolve nitrogenized substances into:

(1) Free nitrogen gas, which passes into the common stock in the atmosphere; and

(2) By combination with oxygen to form nitric acid, which again enters into combination as rapidly as formed with mineral bases, such as lime, etc., which are always present in water, thereby producing harmless, soluble mineral nitrates, which are dissolved as fast as formed and pass off in the effluent.

The mineral nitrates, in any quantity, resulting from the nitrification of the organic impurities of potable waters are not objectionable to human beings, nor are they in any degree nutrient to bacterial life.

A filter of this character will also be fairly self-cleansing—that is, it will tend to keep itself perpetually clear of any accumulation of organic matter in the interstices of the filter; and, inasmuch as the property of self-cleansing is in reality a distinguishing feature of intermittent filters, we may properly, even at the

risk of some little repetition, define at this point the conditions for self-cleansing, namely:

(1) A filter composed in its upper layers of coarse, porous filtering material, as for instance coarse mortar sand, with finer material below.

(2) Intermittency of application of water to such a filter.

(3) The presence in the voids of the filter of the nitrifying organisms in conjunction with a mineral base.

(4) For the most perfect results a temperature of about 70° F.

(5) The application of the water in such limited quantities as to furnish an opportunity for the nitrifying organisms to come in contact with every particle of water passing through the filter.

(6) In the case of water carrying silt in suspension, the provision of a silt-arrestor, through which the water passes before going upon the filter proper.

In regard to condition (3), it may be again stated that nitrifying organisms not only exist naturally in soils, but in the waters of all streams, ponds, lakes, as well. If we make an intermittent filter of clean, coarse sand, etc., as described, and apply any natural water, we find the nitrification nearly nothing in the beginning, but after a time gradually increasing, until finally a maximum rate of nitrification will be attained and, with uniform temperature, maintained indefinitely. The cultivation of the nitrifying organism in pure cultures is now a simple matter and such a filter may, therefore, be brought to a maximum state of efficiency (in less time than by the natural method) by the introduction of artificial cultures of the nitrifying organism, which becoming quickly established upon the surfaces of the sand grains, will produce complete nitrification, the same as ensues as the final result of the slower process of natural inoculation already described.

Such a filter is in the fullest sense of the word self-cleansing. A trial plant which has been used at Lawrence, Mass.,* continuously for five years filtering city sewage at the rate of about

* At the Experiment Station of the Massachusetts State Board of Health.

2.3 gallons per square foot of area per day, still shows the sand clean below the first six inches; it is the opinion of those who have watched the process from day to day that the renewal of the upper six inches on the filter in question will again make the filter practically as good as at the beginning. In filtering ordinary waters where the amount of organic matter to be resolved is far less than in city sewage, the daily quantity of water treated may be proportionately greater, or as a general statement, subject to exception in some cases, we may say that ordinary potable waters may be filtered at the rate of about twenty-five gallons per square foot of filter area per day and yield a sterile effluent.

The following are a few results obtained at Lawrence, from tests in which different hardy varieties of bacteria haye been added to water before filtering through an intermittent filter of the kind here described:

(1) *Bacillus Prodigiosus.*—A harmless but exceedingly hardy variety of bacteria was added in large quantity and the water filtered at the rate of forty-five gallons per square foot per day. The effluent came through absolutely sterile.

(2) *Bacillus Coli Communis.*—A common, hardy, intestinal form, universally present in domestic sewage, was applied in large quantities to a filter, filtering at the rate of forty gallons per square foot of area per twenty-four hours. Result: Absolutely sterile effluent.

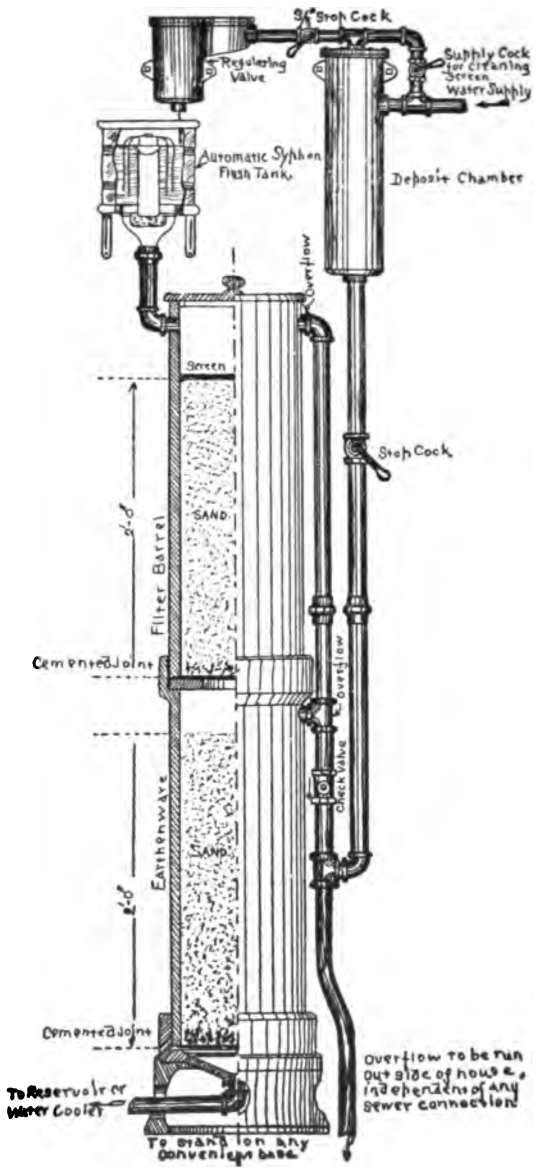
(3) *Bacillus Typhosus.*—The bacillus of typhoid fever was added in large quantities and the water filtered at about a rate of fifty gallons per square foot per day, with a result, as in the previous case, of absolute removal.

As the result of a large amount of experimentation extending over a period of five years, it has been further fully determined that any given filter has a certain maximum rate of work beyond which it is impossible to force it, with a given water, and at the same time secure a complete removal of bacteria. Again, the slower the rate of filtration, the more certain we are to obtain absolute sterilization. In order, therefore, to keep within such bounds as will certainly insure perfect results

always, we lay down the general rule that the rate of filtration should not exceed about twenty-five gallons per square foot of area per day. Very impure waters may be filtered up to or near to this limit and still yield a sterile effluent, while, on the other hand, fairly pure waters may, as indicated, be safely filtered at a considerably higher rate.

In order to illustrate the relation of rate of filtration to degree of purification attained, we will briefly consider another phase of the matter. With a filter five feet in depth and one square foot in area the total cubic contents is five cubic feet, equivalent to 37.5 United States gallons. The voids in the sand will equal about 40 per cent. of the whole volume, or about fifteen gallons. If filtering at the rate of fifteen gallons per day, the amount of water added in that time would just equal the volume of the voids. If filtering at the rate of forty-five gallons per day, the volume added would be three times that of the voids. The effect of increasing the rate upon the length of time the treated water would remain in contact with the minute nitrifying organisms distributed throughout the voids and clinging to the surfaces of the sand grains, is so obvious, therefore, as to require no further discussion.

We may also consider for a moment the real effect of the intermittency of application. In doing this, let us assume by way of illustration that water is applied to such a filter in half-gallon doses at the rate of one gallon per hour. We have then a depth of 0.8 of an inch of water thrown upon the surface of the filter every half hour. With coarse, upper sand this quantity will ordinarily disappear beneath the surface in a few minutes. As it gradually sinks into the sand it spreads itself in thin laminae over the sand grains and at the same time the air is drawn into the space above while water is forced from the bottom. The process of gradual sinking into the interspaces of the filter and outflow of effluent from the bottom goes on until, at the end of a half hour, another dose of water is suddenly applied to the depth of 0.8 of an inch over the entire area of the filter. The air which has passed into the voids, following the downflow into the sand of the previous


3/4" Stop Cock
Regulating Valve
Supply Cock for cleaning Screen
Water Supply
Automatic Syphon Flush Tank.
Deposit Chamber
Overflow
Screen
Stop Cock
SAND
Filter Barrel
Cemented Joint
Overflow
Check Valve
SAND
Earthenware
Cemented Joint
Overflow to be run out side of house, independent of any sewer connection
To Reservoir or Water Cooler
To stand on any convenient base

dose, is mostly retained therein and forced forward through the filter. We have then alternate layers of air and water passing down through the voids, thereby insuring not only thorough mechanical oxygenation of the water, but absolute contact of every particle with the nitrifying organisms in the voids. The movement of the water through the sand even with comparatively high rates of filtration is seen to be quite slow.

The mechanical arrangements for effecting the various operations here described are so clearly shown in the accompanying sketches as to render extended description unnecessary. *

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*Note by the author, January 1, 1897—The original design for a self-cleansing intermittent domestic filter, as exhibited at the time of reading the paper, has been improved in several particulars and Plate A is now substituted in place of the drawing used at that time. The following brief description will enable the general design of the new filter to be readily understood.

The pipe marked "supply" is connected with the mains of an ordinary city water system in the usual manner. It leads into a deposit chamber from which the supply is fed by a connecting pipe, as shown, to a regulating valve. The object of this regulating valve is to ensure an absolutely uniform supply to a siphon from which a given amount of water is automatically discharged at equal intervals upon the filter proper. The deposit chamber is provided with a screen just above the supply pipe for the purpose of catching any floating matter which might interfere with the action of the regulating valve. The object of the deposit chamber is to not only take out the floating matter but also, so far as possible, to rid the water of any slight amount of silt carried in suspension, by simple sedimentation. For this purpose, the area of the deposit chamber is considerably larger than that of the supply pipe. The stream flowing through the regulating valve is very slow; for the ordinary family filter it will not exceed about one gallon per hour. The result is, therefore, that the water has practically no movement in the deposit chamber and any mineral matter in suspension falls to the bottom. The screen and deposited materials may be washed out at intervals by reversing the current through the deposit chamber by proper manipulation of the valves as shown.

From the automatic siphon tank the water passes intermittently upon the surface of the filter where, in order to ensure its uniform distribution over the entire area, it is first received upon a perforated plate marked "screen." In the case of treating very muddy waters where for lack of time the deposit chamber might not thoroughly remove all silt, a silt catcher takes the place of this screen. The filter is made in two sections each containing two feet of sand of graduated degrees of fineness, from coarse sand at the top to fine sand at the bottom. An overflow is also provided by the pipe connections. The effluent from the second filter passes into a reservoir or water cooler.

The filter, as shown by Plate A, is specially designed to be placed in a closet in the second story of a dwelling house, with the effluent pipe leading to a reservoir or water cooler at some convenient location either in the kitchen or pantry below. Ornamental forms may also be provided for use in dining rooms or other public places.

The design as described in the original paper did not include the double filtration, but some experiments made in the last two years have indicated that more satisfactory results may be obtained by the double process. As an additional advantage such an arrangement materially decreases the cost of the filter barrel.

In conclusion it may be stated that there is no reason why, after the intermitting apparatus of one of these filters is properly adjusted, it may not go on furnishing sterile water without any especial attention for several years. Even at the end of that time the only attention required would probably be a mere renewal of the upper layer of sand; at any rate such results may be expected with all waters which are tolerably free of silt. With silt-bearing or muddy waters, the silt catcher would, of course, require occasional attention.

Another point which may be properly noticed is in relation to just the difference between intermittent filtration and continuous filtration through sand, viz.:

In continuous filtration, water is supplied to the upper surface of the filter in large quantities and flows continuously into the voids, completely filling them. Air is, therefore, excluded and the process becomes mostly one of mere straining. The organic matter accumulates in the voids of the filter and in a short time seriously limits its action, precisely as occurs in the Pasteur filter and in all other filters of the straining class. In an intermittent filter, the nitrifying organisms are aërobian forms; that is, they require the presence of oxygen as a necessary condition for their growth. The exclusion of atmospheric air in the continuous process soon results, then, in cessation of active nitrification, although the process may go on ior some time because of the presence of a small amount of dissolved oxygen in all natural waters. The relations of continuous filtration to intermittent and the consequent variations in the degree of nitrification attained in the same filter, have been observed in the series of experiments at Lawrence, already referred to, and the conclusion reached that with sand filters used continuously, the inert organic matter and living organisms both tend to permanently increase, until finally the interspaces become entirely filled. If any disease germs are present in the treated water, the filter may become the source of the greatest danger. Indeed, cases have actually occurred in which the bacilli of typhoid fever have so far increased in the inter-spaces of a continuous filter as to furnish many thousands

in every glassful. As emphasizing the difference between intermittent and continuous sand filters, we may say, in a few words, that intermittent filters destroy disease germs when present in the treated water, while continuous filters, by furnishing a nidus, may lead to their extensive multiplication.

Reference has been made in the foregoing to the effect of filtration on reduction of color in brown-colored waters. On this point it may be said that the Lawrence experiments indicate, with filters five feet in depth, a reduction of color of about 50 per cent. by intermittent filtration. This would so far improve ordinary waters as to render them unobjectionable. The experiments indicate, however, more complete removal of color with deep filters than with shallow, and where very brown-colored, peaty waters are encountered, a greater depth of filter than five feet can possibly be used with good effect.

As to the amount of dissolved oxygen in the effluents from intermittent filters, the experiments show from 90 to 100 per cent. of that necessary for complete saturation at the actual temperature.

Reference may be made to the Pasteur-Chamberland filter, invented by Dr. Chamberland in the laboratory of the great French chemist, Louis Pasteur. This filter is a strainer purely, but when skilfully handled it may be made to yield a sterile effluent. The filtering material is a thin tube of porous porcelain, through which water is forced by pressure. With water containing any amount of impurity the outside of the tube soon becomes covered with a film, composed of the organic or mineral impurities which are naturally present in the water and which, if not frequently removed, soon clog the filter, entirely preventing further action until the tube is cleaned. Again, after the tube has been several times fouled, any bacteria present in the treated water penetrate the pores of the filter tube itself and finally pass through, appearing in the effluent. When this occurs, the tube must be purified by heat before it is again capable of yielding sterile water. In order to understand how bacteria may finally pass through the Pasteur tube we have only to consider that the porosity of the tube is per-

haps equivalent to one micron or say the one twenty-five thousandth part of an inch. Many bacteria, as for instance the typhoid bacillus, are not more than one-fifth of a micron or one one-hundred thousandth of an inch in diameter, while typhoid spores (if they exist) are even much less than this. As a mere matter of mechanics, then, it is clear, if the pores of the filter extend straight through from outside to inside they would offer almost no resistance to the passage, at any rate, of the bacilli and germs of typhoid, but fortunately, as can be determined by a microscopical examination of a section of a Pasteur tube, the pores are sinuous and the windings which any organic particles passing through them must undergo seem to delay for a while their appearance on the inside of the tube. The few thus arrested may multiply in the pores of the tube until finally together with those brought by the throughflowing current the pores may become filled. When this happens the effluent will certainly show the presence of the objectionable germs, whatever they may be. The Pasteur filter, then, while probably efficient when used under skilful supervision in laboratories, cannot be relied upon to furnish sterile water in private houses, where in the majority of cases the skilful supervision will be limited to that of the servant girl.

In continuous filtration on a large scale abroad, it has been found by experience that the purification takes place almost entirely at the surface, where, before any special improvement of the effluent can take place, there must gather a felt-like bacteria jelly which is found to be the effective agent of filtration. With waters of ordinary impurity the surface of the sand becomes so far clogged in about a month's work as to require cleaning, and following which operation there succeeds a period, while a new jelly is forming, during which the improvement of the effluent is only slight. Light appears essential for the formation of this jelly in its greatest perfection, and thus far it has not been specially observed in the smaller filters used for house service here. An examination of a number of such has indicated the penetration of the organic impurities some distance into the sand in the manner already described.

The existence of the bacteria jelly on the surfaces of large continuous sand filters abroad has, however, led to a curious fad in filtration which is, so far as the present speaker knows, purely American—namely, the notion that the use of an alumina jelly in mechanical pressure filters furnishes the indispensable condition for perfect filtration. A discussion of this particular view of filtration would lead too far away from the present subject, and it is only referred to at all as an illustration of one of the essentially erroneous views of filtration which obtained considerable currency before the theory of the purification of water by filtration was as well understood as at the present time.

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